ONE SIZE FITS ALL?

ASSESSMENT OF THE NATIONAL SPACE-BASED INTELLIGENCE, SURVEILLANCE, AND RECONNAISSANCE STRATEGY

BY

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APPROVAL

The undersigned certify that this thesis meets master's-level standards of research, argumentation, and expression.

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DISCLAIMER

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No work of this magnitude is the result of just one individual. While the conclusions and errors contained herein are entirely my own, the shaping and molding of these thoughts is both the direct and indirect result of my interaction with a number of tremendous individuals.

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ABSTRACT

Successful national security strategies rely upon successful national intelligence strategies. By using available intelligence resources to observe and orient, nations can foster success in both decision and action. This work seeks to assess the extent to which the nation's overhead imagery strategy facilitates strategic success for both decision makers and execution agents. Relying on concepts from optimal control theory, a framework built upon objectives, components, and constraints is derived. Building upon this framework the study then establishes the differing and, at times, competitive nature of tactical and strategic objectives; outlines the organizational and technical traits of the current overhead intelligence system; and assesses system optimality via cross-correlation of outlined objectives and traits. Sub-optimalities revealed through the assessment are then considered in context of frequently proposed solutions—organizational integration and system segregation. By reframing the problem to focus on competition's impacts and by assessing the admissibility of solutions in the context of system constraints, this work concludes system optimality will only be achieved through pursuit of both system and organizational segregation.

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Introduction

> *From their inception, reconnaissance satellites have been designed, built, and operated to meet the requirements of both the national intelligence community and the joint force commanders. I believe this approach is posing problems, and those problems are going to get worse as we look to the future. One size may not fit all when it comes to reconnaissance satellites…*
>
> *General Robert C. Kehler*
> *Commander, Air Force Space Command*

> *Last spring the secretary of defense and I decided to pursue the development and acquisition of the new generation electro-optical system…We are trying to balance intelligence for military requirements and for other requirements with technical cost and risk. I happen to know it's balanced because I've received criticism from virtually every side of the spectrum on it so I know I have it just about right.*
>
> *Dennis C. Blair*
> *Director of National Intelligence*

Optimization of the United States' overhead intelligence, surveillance, and reconnaissance (ISR) strategy has been the subject of much recent debate. Headlines from the last year tell the story: *"Intel, AF Sats Must Go Separate Ways,"*[1] *"America's Spy-Sat Debate,"*[2] *"Struggling Spy Satellite Agency Tries to Right Itself."*[3] The list goes on. While few participants in this debate disagree with Director Blair's assessment that overhead imagery "is a core component of our national security,"

[1] Colin Clark, "Intel, AF Sats Must Go Separate Ways: Kehler," *DoD Buzz: Online Defense and Acquisition Journal* (16 Nov 2008), http://www.dodbuzz.com/2008/11/16/intel-af-sats-must-go-separate-ways-kehler/.
[2] Ben Iannotta and Gayle S. Putrich, "Spy-sat Rescue," *C4ISR Journal* 8, no. 5 (2009): 20.
[3] Stew Magnuson, "Lost in Space: Struggling Spy Satellite Agency Tries to Right Itself," *National Defense*, January 2010, 39.

achieving consensus on both an overhead imagery and broader overhead ISR strategy has proven elusive.[4]

The debate has not been limited to professional journals or online blogs. Congressional and political leaders have also taken note. In 2008 Congress chartered an independent assessment panel to study the organization and management of National Security Space (NSS). The panel's final report found that without "significant improvements" in strategies for national security space (to include overhead intelligence programs), the nation's space preeminence would erode to the point that space will cease to provide a "competitive national security advantage."[5] Significantly, the panel found through the course of their assessment, a "widespread sense among informed experts that urgent and fundamental change is needed."[6] Nearly two years later, one may assume that such a sense still exists and yet, no consensus as to the nature of those fundamental changes has been reached.

In another sign of the growing scope of this debate, the House Permanent Select Committee on Intelligence (HPSCI) filed an internal 2008 Congressional report—the *Report on Challenges and Recommendations for United States Overhead Architecture*.[7] Committee members produced the report to "document the issues and challenges" facing the development and execution of an architecture (i.e. strategy) "to serve the demands of the U.S. Intelligence Community and Department of Defense."[8] They found the next few years to be "a defining moment for the United States…with respect to its space architecture" and that

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[4] Quoted in Colin Clark, "President Approves New Spy Satellites," *DoD Buzz: Online Defense and Acquisition Journal* (7 April 2009), http://www.dodbuzz.com/2009/04/07/president-approves-new-satellite-system/.
[5] A. Thomas Young et al., *Leadership, Management and Organization for National Security Space*, (Alexandria, VA: Institute for Defense Analyses, 2008), 4.
[6] Young et al., *Leadership, Management and Organization for National Security Space*, 4.
[7] House, *Report on Challenges and Recommendations for United States Overhead Architecture*, 110th Cong., 2nd sess., 2008, H. Rept. 110-914.
[8] House, *Report on Challenges and Recommendations for United States Overhead Architecture*, 2.

"decisive action is required to chart a successful course to preeminence in space."[9] While achieving agreement on the need for decisive action, consensus on strategy eluded even the committee participants with nine submitting a dissenting view.[10]

Defining and implementing an optimal overhead intelligence strategy has proven so elusive that efforts to do so can be traced back more than a decade. In 1996, Director of the National Reconnaissance Office (NRO), Keith Hall commissioned a panel to review the NRO's mission and strategic vision and to address such major issues as "Is there a need for an NRO?" and "What should be the mission for the NRO in the 21st century?"[11] A few years later, the Fiscal Year 2000 Intelligence Authorization Act established a commission with the sole purpose of evaluating NRO strategies "in order to assure continuing success in satellite reconnaissance in the new millennium."[12] Even the renowned Rumsfeld panel in their *Report of the Commission to Assess United States National Security Space Management and Organization* highlighted the fact that the defense and intelligence communities are "not yet arranged or focused to meet the national security space needs of the 21st century."[13]

With national security dependent upon—and over 15 years of national thought devoted towards—optimization of national overhead intelligence strategies, how is it possible that strategic consensus still eludes the nation? What would lead the director of national intelligence

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[9] House, *Report on Challenges and Recommendations for United States Overhead Architecture*, 2.
[10] House, *Report on Challenges and Recommendations for United States Overhead Architecture*, 9.
[11] Jeremiah Panel, *Defining the Future of the NRO for the 21st Century*, (Washington, DC, 26 August 1996), 2.
[12] Commission to Assess United States National Security Space Management and Organization, *Report of the Commission to Assess United States National Security Space Management and Organization*, (Washington, DC: Department of Defense, 11 January 2001), 144.
[13] Commission to Assess United States National Security Space Management and Organization, *Report of the Commission to Assess United States National Security Space Management and Organization*, ix.

to believe he has it “just about right” while at the same time, the Commander of Air Force Space Command believes the current approach is “posing problems” which will only “get worse as we look to the future?”[14] How should the nation resolve this debate?

This work began as an effort to assess the extent to which the current national overhead ISR strategy is optimized and to recommend potential areas for further optimization. Although the work uncovered issues and potential focus areas, most of these issues have been raised before. Assessment of the current strategy’s optimality is considered beneficial and remains a significant portion of this work. However, understanding why, despite continual identification, these issues have not been resolved is the greater task. If more optimal strategies can be identified, what constrains their implementation? Towards this dual task, this effort now begins.

[14] C. Robert Kehler, "One Size Does Not Fit All" (Address, GEOINT 2008 Symposium, Nashville, TN, 30 Oct 2008).

Chapter 1

Foundations and Frameworks

> *Strategic thought is inevitably highly pragmatic...The history of strategic thought is a history not of pure but of applied reason.*
>
> *Peter Paret*

> *Essentially all strategic comment or strategic criticism is an ad hoc sort of business, having not much more than personal judgment, or hunch, or emotion, or bias, or sometimes even self-interest behind it.*
>
> *Rear Admiral J. C. Wylie*

Strategic success follows true strategic thought. Not strategic thought that is ethereal and theoretical but strategic thought that is, as Paret surmises, pragmatic and applied.[1] Pragmatic application of reason enables optimal resource employment and attainment of desired objectives—the essence of strategic success. Thus, the fundamental challenge for the strategist revolves not around optimization of resources and actions, but rather optimization of the decision making process itself.

While no universal solution to this central strategic challenge has been identified, John Boyd has provided critical insight in his theories on winning and losing. Boyd's observe, orient, decide, and act (OODA) construct highlights the significant fact that observation and orientation precede decision and subsequent action.[2] Only by a continual process of sensing and observing, shaped by orientation, can one collect the information necessary to decide. With successful iterations through Boyd's OODA loops—to include adequate observation and proper orientation—it becomes possible to "constantly adapt" to an unstable

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[1] Peter Paret, "Introduction," in *Makers of Modern Strategy: From Machiavelli to the Nuclear Age*, ed. Peter Paret, Gordon Alexander Craig, and Felix Gilbert (Princeton, NJ: Princeton University Press, 1986), 3.
[2] Grant Tedrick Hammond, *The Mind of War: John Boyd and American Security* (Washington: Smithsonian Institution Press, 2001), 190.

world and ultimately “shape it for (one’s) own ends.”[3] Observation and orientation therefore appear as critical enablers of successful strategic thought and precursors to successful strategic action.

A paradox now arises. Successful strategic decision making hinges upon successful observation and orientation. Successful observation and orientation, however, are themselves dependent upon a strategic decision—namely how to apply one’s resources to achieve observation and orientation success. The recursive closed-loop nature of Boyd’s OODA loop will eventually resolve this paradox. As observations drive decisions they lead to subsequent observations and eventual congruence between observation and decision. Over time, one begins to focus observation on those items critical to the broader decisions being made. While OODA loop iterations drive eventual congruence, purposeful optimization of one’s observation and orientation strategy can significantly accelerate the process and drive broader strategic success. Optimization of one’s observation and orientation strategy thus becomes the true crux of strategic decision making and lies at the heart of ultimate strategic success.

Having isolated observation and orientation strategies as a core element of broader strategic success, how then does one achieve their optimization? Increasing the theoretical understanding of these strategies, while also laying a framework for assessment of their optimization is the purpose of this chapter. Subsequent application of these concepts to the United States’ overhead intelligence strategy forms the purpose of this work.

[3] Hammond, *The Mind of War: John Boyd and American Security*, 191.

Intelligence as Observation and Orientation

Intelligence resources are the means through which nations observe and orient. As Mark Lowenthal suggests, intelligence is "the process by which specific types of information important to national security are requested, collected, analyzed and provided to policy makers."[4] Intelligence is not the collection or assembly of random information but rather focused collection (i.e. observation) and analysis (i.e. orientation) of specific types of information to support specific purposes.

The first of these purposes is the collection and analysis of information "to support the policy process."[5] As policy makers formulate policy (i.e. decide), they have a "constant need for…intelligence that will provide background, context, information, warning and…assessment of risks, benefits, and likely outcomes" of policy options.[6] Intelligence used to support policy makers in the decision phase of the policy process will be termed strategic intelligence.

Not all intelligence is strategic intelligence, however. Despite Lowenthal's assertions that "intelligence exists solely to support policy makers in myriad ways" and "any other activity is either wasteful or illegal," intelligence also serves a useful role to those agents more focused upon policy execution (i.e. the acting portion of the OODA loop) than policy formulation.[7] If a nation's observation and orientation resources can provide life-saving intelligence to the soldier in the field, is such an activity wasteful? Intelligence used in this manner will not lead to better strategic policy formulation, but will lead to better tactical success for those who seek to execute the policy objectives. Intelligence used to facilitate execution of a policy will be termed tactical intelligence.

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[4] Mark M. Lowenthal, *Intelligence: From Secrets to Policy*, 4th ed. (Washington, DC: CQ Press, 2009), 8.
[5] Lowenthal, *Intelligence: From Secrets to Policy*, 3.
[6] Lowenthal, *Intelligence: From Secrets to Policy*, 3.
[7] Lowenthal, *Intelligence: From Secrets to Policy*, 2.

The August 2009 release of *The National Intelligence Strategy of the United States of America* recognized this distinction. This document outlined four overarching goals for the United States' Intelligence Community (IC).[8] The first two of these goals read:

- "Enable wise national security policies by continuously monitoring and assessing the international security environment to warn policymakers of threats and inform them of opportunities. (The IC) will provide policymakers with strategic intelligence that helps them understand countries, regions, issues, and the potential outcomes of their decisions."[9]
- "Support effective national security action. The IC will deliver actionable intelligence to support diplomats, military units, interagency organizations in the field, and domestic law enforcement organizations at all levels."[10]

The first of these goals clearly highlights the role of strategic intelligence in the policy making process while the second emphasizes the effectiveness of tactical intelligence in supporting national security action. Both strategic and tactical intelligence, however, fill a "vital role" in ensuring the nation's continued security in the "complex and rapidly shifting international security landscape."[11] This conclusion matches the previous assertion that success is contingent upon observation and orientation (i.e. intelligence) and strengthens the need for optimization of national intelligence strategies in fulfillment of both strategic and tactical roles.

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[8] *The National Intelligence Strategy of the United States of America*, (Washington, DC: Office of the Director of National Intelligence, August 2009), 5.
[9] *The National Intelligence Strategy of the United States of America*, 5.
[10] *The National Intelligence Strategy of the United States of America*, 5.
[11] *The National Intelligence Strategy of the United States of America*, 1.

Towards Optimization of the Whole

Independent of the tactical or strategic needs being met, intelligence sources and methods can vary dramatically. Both domain and target differences drive significant deviation in systems and techniques used to perform the observation and orientation deemed vital to national security. A strategy for optimization of observation and orientation from space will differ dramatically from a strategy designed to optimize the same mission from airborne assets. Similarly, while "the main sources" of intelligence—signals intelligence (SIGINT), imagery intelligence (IMINT), and human intelligence (HUMINT)—work together to form a greater whole, optimal strategies for each will obviously vary.[12]

Thus, while pursuit of an effort to optimize the overarching national intelligence strategy would be the ideal, the extent of the intelligence enterprise makes such an effort unwieldy and such an outcome unlikely. In this context, the Air Force's desire to "develop the entire (ISR) process as a single entity" is commendable but unachievable, as such.[13] Optimization of the entire process can only be achieved through optimization of the component strategies. This is not an argument for "stovepiped ISR systems" nor is it a case for "arbitrarily reserving certain ISR missions" for domain specific platforms.[14] However, it is an assessment that, in the context of the larger intelligence objective, a sub-optimal strategy in a given domain or function may drive sub-optimality of the entire ISR system.

The national overhead imagery strategy is a case in point. Assets exist in all other domains to collect imagery. Similarly, space assets can be used to perform other types of observation beyond just imagery

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[12] Michael Herman, *Intelligence Power in Peace and War* (New York: Cambridge University Press, 1996), 81.
[13] David A. Deptula, *Lead Turning the Future: The 2008 Strategy for United States Air Force Intelligence, Surveillance and Reconnaissance*, (Washington, DC: Headquarters, United States Air Force, July 2008), 12.
[14] Deptula, *Lead Turning the Future: The 2008 Strategy for United States Air Force Intelligence, Surveillance and Reconnaissance*, 12.

collection. Any national overhead imagery strategy must be developed within the context of both the larger national imagery and overhead intelligence strategies. However, failure to optimize the overhead imagery strategy itself, subject to the constraints of this larger context, will result in degradation of all strategies. It is this conclusion that allows a work such as this to focus on one specific aspect of the national intelligence strategy in hopes of optimizing not only the specific aspect under study but the system as a whole.

Strategy and Optimization

Before proceeding with an assessment of the extent to which the nation's overhead imagery strategies are optimized, two concepts must be explicitly defined—strategy and optimization. Concluding that intelligence strategies need to be optimized is only slightly beneficial. Of more interest is identification of a framework within which strategy can be assessed and against which strategy can be optimized.

Strategy

Many definitions of strategy do not lend themselves well to assessment. For example Baron De Jomini's summarization of strategy as the "art of making war upon the map" suffers not only from limited scope but its reliance on strategy as art also precludes objective assessment.[15] Other definitions, such as Moltke's conclusion that strategy is "a system of expedients," broaden strategy's scope but even these broader definitions do little to aid objective assessment.[16] Absent a more useful definition, one is left no choice but to agree with Wylie, that

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[15] Baron De Jomini, *The Art of War*, trans. Capt. G.H. Mendell and Lieut. W.P. Craighill (Radford, VA: Wilder Publications, LLC., 2008), 51.
[16] Helmuth Moltke, *Moltke on the Art of War: Selected Writings*, ed. Daniel J. Hughes, trans. Daniel J. Hughes and Harry Bell (New York: Presidio Press, 1993), 124.

"all strategic comment or strategic criticism is an ad hoc sort of business."[17]

Fortunately, a more useful definition can be found. Paret comes close in the opening lines of his survey of great strategic theorists. Consolidating many concepts into one, Paret concludes, "Strategy is…based on and may include the development, intellectual mastery, and utilization of all the state's resources for the purpose of implementing its policy in war."[18] Setting aside the limitation of strategy to achieving policy in war, Paret's definition creates a useful framework for strategic assessment. If strategy is simply the use of available resources for the purpose of implementing policy, strategic assessment becomes possible through understanding and assessing three primary strategic components: a) available resources, b) existing relationships, and c) desired objectives. It is to this context that the term strategy will be referred and to this framework that strategies will be assessed throughout this work.

Optimization

Many definitions of optimization suffer from the same shortcoming as definitions of strategy highlighted previously—while accurate, they do not lend themselves well to assessment. Webster's definition highlights well this deficiency. While defining optimization as the "act of making something as fully perfect, functional, or effective as possible," is technically correct, the definition does little to assist in assessing optimality.[19] How does one assess whether or not something is as *fully* perfect or effective as possible?

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[17] J. C. Wylie, *Military Strategy: A General Theory of Power Control*, Classics of Sea Power (Annapolis, MD: Naval Institute Press, 1989), 1.
[18] Paret, "Introduction," 3.
[19] Merriam-Webster, Inc., *Webster's Ninth New Collegiate Dictionary* (Springfield, MA: Merriam-Webster Inc., 1991), 829.

By turning to the discipline of optimal control, assessment of optimality becomes possible. This discipline, which defines optimization as the determination of "control signals that will cause a process to…minimize (or maximize) some performance criterion" does not dramatically modify Webster's definition of optimality.[20] Optimal control theory, however, goes beyond definition to define a framework for assessing optimality. It is in this framework that definitional shortcomings begin to disappear.

To determine the control signals that will optimize a system's performance, optimal control theorists create models composed of three distinct parts: a) a description of the process to be controlled; b) a statement of constraints; and c) a performance criterion.[21] Having defined the system, outlined allowable and restricted behavior, and specified the desired performance, optimal control is simply a process whereby the control signals needed to enable the system to optimize the specified performance are calculated. Such a process relies little on subjectivity regarding what is functional or effective.

While the concepts of optimal control theory are a step closer to development of an objective framework for assessment of optimality, even these concepts do not fully achieve the desired goal. Although the optimal control model does serve to define the "something" in Webster's definition and also further clarifies, through the use of performance criterion, what is meant by system effectiveness, the model does little to clarify what is meant by "as *fully*…as *possible*."[22] How does one objectively assess when a system has reached full perfection or effectiveness?

To fully develop an objective framework one must also turn to the related field of operations research. Like optimal control, the goal of this

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[20] Donald E. Kirk, *Optimal Control Theory: An Introduction*, Prentice-Hall Networks Series (Englewood Cliffs, NJ: Prentice-Hall, 1970), 3.
[21] Kirk, *Optimal Control Theory: An Introduction*, 4.
[22] Merriam-Webster, *Webster's Ninth New Collegiate Dictionary*, 829. Emphasis added.

field is to identify optimal solutions—"a best possible course of action."[23] In this field, however, *best* does not necessarily equate with "as fully…as possible."[24] Achieving an absolute maximum or minimum is no longer the goal. Instead, through the introduction of the concept of "satisficing," operations research practitioners transfer the meaning of optimal from best to "good enough."[25] While best solutions are still sought, "if a solution is found that enables all…goals to be met, it is likely to be adopted without further ado."[26]

Through a combination of the concepts of operations research and optimal control theory, optimization can be summarized as the following: Control of a system subject to a set of constraints to achieve performance from the system that is "good enough."[27] Assessment of a system's optimality is now possible through separate analysis of the system, the constraints on the system, and the predefined performance criterion. Such a framework thus enables objective assessment.

Note the striking parallels between this consolidated theory of optimization and the previously delineated strategy definition: Utilization of resources (i.e. the system) subject to various relationships (i.e. constraints) to achieve policy objectives (i.e. performance criterion). The combination of the two definitions will form the framework for assessment this study will follow.

Plan of Attack

The initial goal of this study is to assess the optimality of the United States' current strategy for overhead imagery intelligence objectively. The challenge, however, lies in the question of optimality. As

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[23] Frederick S. Hillier and Gerald J. Lieberman, *Introduction to Operations Research*, 6th ed., McGraw-Hill Series in Industrial Engineering and Management Science (New York: McGraw-Hill, 1995), 3.
[24] Merriam-Webster, *Webster's Ninth New Collegiate Dictionary*, 829.
[25] Hillier and Lieberman, *Introduction to Operations Research*, 15.
[26] Hillier and Lieberman, *Introduction to Operations Research*, 15.
[27] Hillier and Lieberman, *Introduction to Operations Research*, 15.

the quote from Admiral Wylie that began this chapter demonstrates, assessment of strategic optimality, however, is often viewed as an inherently subjective matter. Through use of the framework laid out in the previous section, it is expected that the assessments to follow will be based on more than "personal judgment, or hunch, or emotion, or bias."[28] While complete removal of subjectivity in strategic assessment remains impossible, use of an objective framework should aid in attempts to assess if current strategies are "good enough."[29]

Using the previous framework, this work will proceed as follows. Chapter 2 defines the performance criterion—what objective or objectives is the nation's overhead imagery strategy intended to fulfill? Chapter 3 then focuses upon the development of understanding regarding the system to be controlled. Specifically it outlines the organizations and system traits that comprise a national overhead imagery strategy. Having thus detailed two primary components of the optimization problem to include resources and objectives, Chapter 4 assesses performance of the strategy against the identified objectives—is the strategy good enough, or are some goals not being met? With weaknesses identified, Chapter 5 then seeks to discover recommendations for improved system performance.

As discussed in the introduction to this work, most of the conclusions from Chapter 4 are not new or innovative. Rather, they are restatements of assessments that have surfaced through various reviews and studies over the course of the last decade. Chapter 5 attempts to build upon this analysis by focusing upon the system constraints which have limited implementation of previous recommendations. By focusing upon previous recommendations in the context of system constraints, Chapter 5 derives new recommendations for system optimality which, if implemented, would allow strategic optimization of the overhead ISR

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[28] Wylie, *Military Strategy: A General Theory of Power Control*, 1.
[29] Hillier and Lieberman, *Introduction to Operations Research*, 15.

system—something the nation has been unable to achieve in the previous fifteen years.

Caveats

This study seeks to answer the question of strategic optimality in one very specific case—overhead intelligence and even more specifically overhead *imagery* intelligence. Such specificity is driven first and foremost by the requirement that this work remain unclassified. While various authors discuss the existence and performance of non-imagery overhead intelligence satellites, finding reliable unclassified details on these systems is difficult enough.[30] Attempting to assess the optimality of these non-imagery systems outside the classified world would prove impossible.

In a similar sense, while the existence of overhead imagery systems has been readily acknowledged, it should also be noted that many specific details of current imagery systems remain classified.[31] For the most part, specific system details should not drive the optimality of the strategic solution. These details, while relevant to attempts at optimization of tactical level collection strategies, are much less so at the strategic level this work seeks to remain. In the event such details are needed, they will be provided simply as speculation based on open-source literature. Use of these references should not be viewed as confirmation of their accuracy or lack thereof.

The specificity of this work is also driven by the limited time allotted to execute this assessment. As a full time student with graduation requirements looming, attempting an assessment of anything broader than the national overhead space-based imagery strategy would rapidly exceed available time and resources (a sub-optimal strategy in its

[30] For example see: William E. Burrows, *Deep Black: Space Espionage and National Security* (New York: Random House, 1986), 221.
[31] Ben Iannotta and Gayle S. Putrich, "Spy-sat Rescue," *C4ISR Journal* 8, no. 5 (2009): 20.

own right). The national overhead imagery strategy and any associated sub-optimalities discovered are likely to be tied to larger intelligence and Department of Defense community issues and relationships. Where such issues are found, they will be noted. This study is not, however, an effort to reform either community. Rather, it is simply an attempt to suggest improvements to performance of a specific mission at the seam between those communities.

One final caveat is in order. To a large extent, the research required to execute this assessment was based on the gracious willingness of current and former senior space and intelligence leaders to provide data and opinions through personal interviews. In the desire for objectivity, every effort was made to obtain opinions from senior leaders across the diverse spectrum of organizations with vested interests in this debate. Despite these efforts, it should not be assumed that the organizational opinions of all vested agencies or bodies have been fully captured. Additionally, while permission has been received from every individual quoted herein, statements were given in the spirit of research and assessment and should not be received as official declarations from either the office these individuals hold or the individuals themselves.

Conclusion

Successful national security strategies rely upon successful national intelligence strategies. By using available intelligence resources to observe and orient, nations can facilitate success in both decision and action. While optimization of overarching intelligence strategies is the ideal, a more realistic goal is optimization of sub-component strategies in support of the larger ideal. This work seeks to assess the optimization of one very specific component—the national overhead imagery strategy. Through assessment of the available resources, desired objectives and system constraints, recommendations for improved national security will follow.

Chapter 2

Objectives

> *Although the "tools" might be common between the intelligence community and joint commanders, their purposes are not.*
>
> *General Robert C. Kehler*
> *Commander, Air Force Space Command*

As introduced previously, the value of national intelligence strategies derives from the extent these strategies contribute to broader security strategies and objectives. Specifically, the optimality of an intelligence, surveillance, and reconnaissance (ISR) strategy relates directly to the contribution such a strategy makes to either successful decision making or effective action in support of national security objectives. Assisting policy makers to "understand countries, regions, issues, and the potential outcomes of decisions"—i.e. strategic intelligence—is one primary goal of ISR strategies.[1] Providing "actionable" or tactical intelligence to support effective national security execution is the other.[2]

As optimization of any system depends first and foremost upon the objectives being sought, identifying the qualities of effective strategic and tactical intelligence becomes critical to the larger goal of assessing ISR system optimality. While acknowledging the dual purpose intelligence plays in assisting both decision makers and execution agents is a first step, additional insight into the differing purposes of each group is needed. To what extent are the qualities of strategic and tactical intelligence the same? To what extent do they differ? Only by identifying answers to these questions can the larger question of system optimality

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[1] *The National Intelligence Strategy of the United States of America*, (Washington, DC: Office of the Director of National Intelligence, August 2009), 5.
[2] *The National Intelligence Strategy of the United States of America*, 5.

be found. This chapter seeks, therefore, to illuminate the more precise objectives an optimal national overhead ISR strategy should fulfill.

"Deep Fundamentals"[3]

The fundamental product of all intelligence activity is the derivation of knowledge from which subsequent decision or action can be driven. The value of a given piece of intelligence and the system from whence it derives can therefore be measured by the extent to which the intelligence or intelligence system contributes to an ever increasing pool of knowledge—a concept comparable to Lieutenant General David Deptula's "emerging knowledge-based environment."[4] If positive contribution to the overall knowledge-based environment is the ultimate objective of ISR, identifying a framework across which the contributions of various systems can be compared is a first step towards maximizing the contributions of a given system—in this case, the overhead ISR system.

While multiple qualitative frameworks are possible for assessing the value of a given intelligence system's contributions to the broader knowledge-based environment, the framework outlined in *The 2008 Strategy for United States Air Force Intelligence, Surveillance and Reconnaissance* forms the basis of this work. In his role as the Air Force's Deputy Chief of Staff for Intelligence, Surveillance and Reconnaissance (A2), Lieutenant General Deptula sought a framework against which to assess "the relative values of individual technologies and systems, and alternative portfolios of technologies and systems" for future ISR system procurements.[5] The resultant framework succeeds in

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[3] David A. Deptula, *Lead Turning the Future: The 2008 Strategy for United States Air Force Intelligence, Surveillance and Reconnaissance*, (Washington, DC: Headquarters, United States Air Force, July 2008), 16.
[4] Deptula, *Lead Turning the Future: The 2008 Strategy for United States Air Force Intelligence, Surveillance and Reconnaissance*, 16.
[5] Deptula, *Lead Turning the Future: The 2008 Strategy for United States Air Force Intelligence, Surveillance and Reconnaissance*, 17.

documenting currently relevant ISR characteristics while simultaneously avoiding potential pitfalls of domain or platform bias or specificity. Additionally, while its role in execution of national security strategies has the potential to focus Air Force intelligence priorities solely on tactical requirements, the approach taken by the Air Force A2 team of hearkening back to the "deep fundamentals" results in a framework that avoids this pitfall and comprehensively documents both tactical and strategic ISR characteristics.[6]

The "deep fundamentals" outlined by Lieutenant General Deptula include "time, space, matter and knowledge."[7] These "deep fundamentals" impact "all human activities, from the way humankind cooperates and innovates to the way [humankind] make[s] war."[8] The extent to which various systems exploit these deep fundamentals forms the theoretical basis of the Air Force's 2008 ISR strategy.

Fully illuminating the deep fundamentals concept or even eliciting agreement with such a foundation is not the intent of this work, however. Of more interest is the framework to which comparison across these deep fundamentals leads. By further decomposition of the fundamentals of time, space, matter, and knowledge, Lieutenant General Deptula identifies "key components" critical for "long-term success".[9] These seventeen key components, summarized in Table 1, are directly translatable as ISR objectives and become a starting point for understanding the specific purposes a national overhead ISR strategy is intended to fulfill.

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[6] Deptula, *Lead Turning the Future: The 2008 Strategy for United States Air Force Intelligence, Surveillance and Reconnaissance*, 17.
[7] Deptula, *Lead Turning the Future: The 2008 Strategy for United States Air Force Intelligence, Surveillance and Reconnaissance*, 16.
[8] Deptula, *Lead Turning the Future: The 2008 Strategy for United States Air Force Intelligence, Surveillance and Reconnaissance*, 16.
[9] Deptula, *Lead Turning the Future: The 2008 Strategy for United States Air Force Intelligence, Surveillance and Reconnaissance*, 17.

Table 1: Seventeen Key ISR System Objectives

Objective	Definition
Time-to-Think	Amount of time a system gives for "orienting"
Adaptability	Speed and ease with which a system can adjust to new conditions and requirements.
Time-on-Station	Amount of time a system can collect on or observe an area of interest.
Responsiveness	Time it takes a system to reach target area.
Spectrum of Operations	Utility of a system across the spectrum of operations (i.e., humanitarian response, major theater war, irregular warfare, etc.).
Coverage	Total area a system can surveil at any given time.
Discrimination	System's ability to accurately discern legitimate targets among many similar objects, especially mobile targets.
Accuracy	Ability of system to precisely geo-locate a target or object of interest.
Survivability	System's ability to cover any area of interest without suffering loss of capability.
Penetration	Ability of system to sense the enemy even when enemy takes action to prevent access.
Sustainment	Degree of system support required (e.g., personnel, training, maintenance) over time.
Replacement	Ease of fielding replacement systems.
Surge	Ability to deploy additional systems within operationally-significant timelines.
Multi-phenomenology	Number of different types of intelligence a system can collect.
Interoperability	Degree of sharing a system facilitates across different types of sensors and systems.
Uniqueness	Whether a system is the only means to collect against an area of interest under certain conditions.
Correlation	How well a system's disparate data can be synthesized to provide understanding which creates knowledge.

Source: Adapted from David A. Deptula, Lead Turning the Future: The 2008 Strategy for United States Air Force Intelligence, Surveillance and Reconnaissance, Washington, DC: Headquarters, United States Air Force, July 2008.

The Rationale for Space-Based Overhead ISR

National strategies for intelligence, surveillance, and reconnaissance extend well beyond strategies for collection from space-based platforms. The national ISR portfolio consists of systems in all domains including “space, air, ground, cyber, air, sea and human.”[10] While platforms in each domain provide similar types of data to the integrated ISR mission, the extent to which these systems fulfill the seventeen objectives delineated in Table 1 varies dramatically. For example, while a human collection asset may achieve extraordinary levels of uniqueness, coverage provided by such a system (i.e. one individual) will be minimal. Having identified the desirable components of generic ISR systems, the next step in assessing the optimality of an overhead ISR strategy is identification of specific areas in which space-based systems provide benefit to a national ISR strategy.

Developing and deploying an ISR platform in space is both expensive and risky. As a case in point, consider the experimental L-21 satellite launched by the United States in December 2006.[11] Built by the National Reconnaissance Office (NRO) to test aspects of new ISR technologies, the platform, which reportedly cost “hundreds of millions of dollars,” lost touch with operators shortly after reaching low-earth orbit.[12] Despite best efforts to re-establish contact, officials eventually were forced to declare the satellite a total loss. To eliminate risks associated with the impending natural re-entry of the platform, “Operation Burnt Frost” was conducted in February 2008, at the cost of additional “tens of millions of dollars”, completely destroying the satellite.[13] All told, years of effort and millions of dollars resulted in very

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[10] Deptula, *Lead Turning the Future: The 2008 Strategy for United States Air Force Intelligence, Surveillance and Reconnaissance*, 19.
[11] Andrea Shalal-Esa, "U.S. Spy Satellite Declared Loss, To Drop from Orbit," *Reuters* (2 Aug 2007), http://www.reuters.com/article/idUSN0225519020070803.
[12] Shalal-Esa, "U.S. Spy Satellite Declared Loss, To Drop from Orbit."
[13] Associated Press, "Satellite-Debris Recovery Team Ready for Action," *Fox News* (22 Feb 2008), http://www.foxnews.com/story/0,2933,331855,00.html.

little gain to the overarching national ISR strategy. Such a result reveals the risk inherent in pursuing ISR missions from space.

Given such high risks, there must be significantly high rewards to justify pursuing ISR missions from space. Understanding the benefits that justify pursuing ISR through modern methods in space requires one look no further than the age-old doctrine of seizing and holding the high ground. As theorist and strategist Colin Gray suggests, "Space is but the latest variant of the 'high ground'."[14] Therefore, the benefits that flow from space are simply variations of two benefits that have always followed control of the high ground—perspective and an accessibility duality.

Perspective

In seeking to identify the imperatives for pursuing missions from space, noted astronautics expert Jerry Sellers correctly places "global perspective" at the top of his list. [15] This global perspective is first and foremost amongst the advantages space provides. While not an orbital mechanics expert, in his discussion of space strategies Gray correctly surmises that due to the laws of orbital motion, satellites can be "available globally as either a regularly repeating or a constant overhead presence."[16] These laws allow the nation with the desire and ability to take advantage of them, the possibility to create what William Burrows has qualified as a "truly global collection capability."[17] No other domain can offer the extensive benefits across the objectives of adaptability, responsiveness, and coverage that space systems operating on a "truly

[14] Colin S. Gray, *Modern Strategy* (New York: Oxford University Press, 1999), 260.
[15] Jerry Jon Sellers, *Understanding Space: An Introduction to Astronautics*, Revised 2nd ed., Space Technology Series (New York: McGraw-Hill, 2004), 3.
[16] Gray, *Modern Strategy*, 261.
[17] Quoted in William E. Burrows, "Satellite Reconnaissance," in *The Intelligence Revolution and Modern Warfare*, ed. James E. Dillard and Walter T. Hitchcock (Chicago: Imprint Publications, 1996), 187.

global scale" provide.[18] It is to gain this greater perspective that control of the ultimate high ground is sought.

The Duality of Accessibility

Traditionally, greater perspective has not been the only benefit gained by those who sought and held the high ground. Certainly establishing a location from which to—in Gray's words—"look down on friend and foe" was benefit enough to justify pursuing the high ground.[19] In so pursuing, however, one simultaneously gained ground that was also "relatively difficult to reach and grasp" due to the physical reality that "attacking uphill has never been easy."[20]

As a direct result of physical realities, two additional benefits flow to those who seize and hold the high ground. First, systems built to take advantage of the high ground are difficult to remove. Their relative inaccessibility greatly aids the defensibility of these systems. Second, and somewhat paradoxically, the inaccessibility of these systems ultimately affords these systems themselves greater accessibility to perform desired missions. Those who control the high ground cannot be easily dissuaded from observing even those areas a foe would prefer they do not see. Inaccessibility and accessibility are two sides of the same coin—both brought about by the physical realities of the high ground.

While orbital physics differs from traditional physics in many respects, the duality of the inaccessibility and accessibility of the high ground remains constant. As Gray points out, if attacking uphill is difficult, attacking up earth's gravity well is certainly no easier.[21] When Iran launched an indigenously built research rocket in 2008 it claimed to become just the eleventh nation possessing technology to "build satellites

[18] Burrows, "Satellite Reconnaissance," 187.
[19] Gray, *Modern Strategy*, 260.
[20] Gray, *Modern Strategy*, 260.
[21] Gray, *Modern Strategy*, 260.

and launch rockets into space."[22] Assuming Iran's claim to be true, in more than half a century since space exploration began, less than ten percent of the nations of the earth have gained access to the domain.

Clearly, those who do gain access to space benefit from the dual nature of accessibility traditionally experienced by those who hold the high ground. Specifically, their systems remain out of reach to the majority of the world while simultaneously gaining the ability to peer beyond national borders. This duality contributes directly to the ISR objectives of survivability and penetration, and when combined with the previous benefit of perspective answers the question "Why ISR from space?" As the 2000 Commission for Review of the National Reconnaissance Office succinctly summarized, "Space has proven to be the most effective means for gaining frequent, *assured access* to denied areas on a *global basis* (emphasis added)."[23]

The Intra-Domain Objective Trade Space

While the space domain affords both decision makers and execution agents ISR benefits to a degree not present in other domains, the extent to which a given space system meets ISR objectives is not universal. The high ground of space grants space systems a comparative perspective and access advantage over systems deployed in other domains. However, when compared across systems within the space domain, overall system optimality has the potential for wide variation. The extent to which ISR objectives are met remains extremely system dependent. By tailoring orbits, optics, or myriad other system parameters, some objectives may be purposefully emphasized at the expense of others. Understanding intra-domain objective trades—or more importantly, understanding the intra-domain objective trade

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[22] Ali Akbar Dareini, "Iran Unveils Space Center, Launches Rocket," *MSNBC* (4 Feb 2008), http://www.msnbc.msn.com/id/22995937/.
[23] National Commission for the Review of the National Reconnaissance Office, *The NRO at the Crossroads*, (Washington, DC, 2000), 11.

space—is the next piece in the search to illuminate the precise objectives an optimal national overhead ISR strategy should fulfill.

A Diversity of Objectives

Returning to the concept of knowledge-based environments, the rationale for the purposeful emphasis on some objectives at the expense of others becomes clear. Simply put, the optimal knowledge-based environment differs for decision makers and execution agents. As previously concluded, the role of ISR is to contribute to an ever increasing pool of knowledge that forms the basis for either strategic decision-making or strategic execution. While both decision makers and execution agents rely on knowledge pools, the optimal nature of those pools, i.e. the optimal nature of their knowledge-based environments, will vary dramatically. Different knowledge is needed to make a decision than is needed to act.

This conclusion forms the foundational premise of this study as succinctly summarized by General Kehler at the beginning of this chapter. While both decision makers and execution agents seek knowledge through the use of space-based ISR systems, fundamentally, "their purposes are not (the same)."[24] The objectives a system must meet to fulfill the needs of decision makers varies from the objectives an optimal execution agent supporting system must satisfy.

Emphasizing each party's different purposes is not to say that some portion of the seventeen ISR objectives is only applicable to either decision makers or execution agents. In reality, all seventeen objectives are necessary for either mission and significant overlap is present between each party's needs. The question, therefore, becomes one of emphasis. The optimal solution for each role will necessarily have different emphases on multiple parameters. Figure 1 is a notional

[24] C. Robert Kehler, "One Size Does Not Fit All" (Address, GEOINT 2008 Symposium, Nashville, TN, 30 Oct 2008).

representation of these differences.[25] By ranking each objective as a high, medium, or low need for decision makers and execution agents the shape of the problem begins to emerge. The existence of extreme areas of overlap but also, and more importantly, areas of difference should be noted. An optimal system solution—one that meets the needs of both decision makers and execution agents—must cover not only the areas of overlap but the areas of difference, as well.

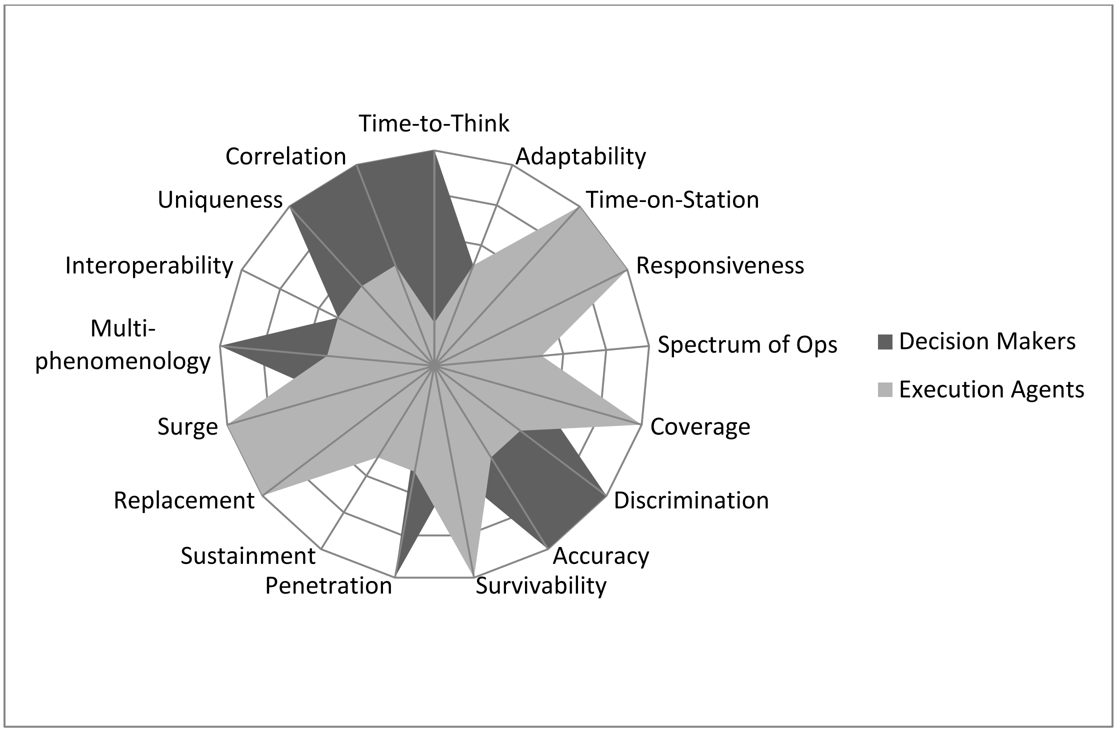

Figure 1: Notional Intra-Domain Objective Trade Space
Source: Author's Original Work

[25] Figure 1 is not intended to be an authoritative representation of the specific objective needs of decision makers as compared to execution agents. Differences of opinion as to where a given objective should be ranked for each party are bound to exist. The intent of Figure 1 is therefore not to identify specific objective rankings but rather to highlight the different objective emphasis required to achieve optimal solutions for either party.

Critical Variables and the Scope of the Optimization

In assessing the intra-domain trade space and attempting to identify objectives for system optimization, introduction of one additional concept is required. This is the systems theory concept of "critical variables."[26] As described by Dietrich Dorner, critical variables are those variables which are the "key variables of a system" and altering them exerts a "major influence" on the system.[27] Critical variables are to be contrasted with indicator variables whose alteration will exert little influence on the overall system.

As highlighted previously, simply by virtue of the nature of the domain, placing an ISR system in space will produce certain benefits. These include those objectives such as survivability and coverage related to the duality of accessibility and perspective. As these benefits are available to all space systems, optimizing a system to take advantage of these traits is like altering indicator variables in systems theory—the overall system impact will be minimal.

Similarly, one could attempt optimization against all seventeen objectives, thereby ensuring all possible needs are met. While such an effort makes theoretical sense, it is practically unachievable. The concept of strategic optimization implies allocation of limited resources making a strategy that seeks to do everything an unrealistic solution.

The solution therefore lays in optimizing against the critical variables—those that can exert major influence. By limiting the scope of the optimization to those variables that really matter the most effective optimization can be achieved. As Figure 1 highlights, critical objectives differ between deciders and actors. Therefore, identifying these critical

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[26] Dietrich Dörner, *The Logic of Failure: Why Things Go Wrong and What We Can Do to Make Them Right*, trans. Rita Kimber and Robert Kimber, 1st American ed. (New York: Metropolitan Books, 1996), 75.
[27] Dörner, *The Logic of Failure: Why Things Go Wrong and What We Can Do to Make Them Right*, 75.

objectives will be key in assessing the current system's optimality for both parties and is the task to which one must now turn.

The Critical Variable for Decision Makers

In 1955, James R. Killian, Jr. headed a Technological Capabilities Panel (TCP) to assess the "intelligence requirements that were thought to be necessary because of the apparent danger posed by the Soviet Union's growing…missile capability."[28] As part of their final report to President Eisenhower, the panel recommended the development of reconnaissance satellites with the following statement: "If intelligence can uncover a new military threat, we may take steps to meet it. If intelligence can reveal an opponent's specific weakness, we may prepare to exploit it. With good intelligence we can avoid wasting our resources by arming for the wrong danger at the wrong time. Beyond this, in the broadest sense, intelligence underlies our estimate of the enemy and thus helps to guide our political strategy."[29] The Killian panel's justification for reconnaissance satellites is a concise and classic definition of strategic intelligence. Developing estimates of the enemy and guiding political strategy in response to revealed threats or weaknesses is the primary purpose of intelligence for decision makers.

In support of this primary purpose, the critical variable for strategic intelligence systems is straightforward—strategic intelligence systems must be able to discover enemy threats and weaknesses, even those threats and weaknesses foes would prefer to hide. In a 2010 interview, the former director of the National Security Space Office (NSSO) and former director of the Signals Intelligence Directorate in the National Reconnaissance Office, Major General (retired) James B. Armor, Jr., expertly summarized this fundamental objective of systems supporting the strategic intelligence community. As he stated, what

[28] Burrows, "Satellite Reconnaissance," 184.
[29] Quoted in Burrows, "Satellite Reconnaissance," 184.

decision makers really need is, "A capability that adversaries can't even conceive that you have. When push comes to shove it's that exquisite capability that they (the strategic intelligence community) are really after."[30]

At first glance the critical variable of exquisite, inconceivable capabilities seems to parallel the objective of penetration as previously outlined—the ability to "sense the enemy even when the enemy takes action to prevent access."[31] While penetration is an important element, the critical variable for decision makers really entails much more. Combining the objectives of discrimination, accuracy, multi-phenomenology, and uniqueness leads one closer to the entirety of the concept. Decision makers are looking for a "*low profile*, zero risk, and secure means of collecting highly *sensitive* intelligence (emphasis added)."[32] The need for exquisite, inconceivable collection methods is the true critical variable for ISR systems that support decision makers and optimality of the existing system will be assessed by the extent to which it meets this objective.

The Critical Variables for Execution Agents

In a speech on this subject given at the 2008 Geospatial Intelligence (GEOINT) conference, General Kehler made the following assertion, "Military services and national intelligence agencies can use data collected by and for the other, but for operations the information they will need will differ in content, quality, focus, frequency and timeliness."[33] The general's assertion goes beyond a simple statement that differences exist to list key areas of divergence. This list of areas of

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[30] Major General (retired) James B. Armor, Jr., interview by the author, 22 February 2010, Beltsville, MD. Audio recording in author's personal archives.
[31] Deptula, *Lead Turning the Future: The 2008 Strategy for United States Air Force Intelligence, Surveillance and Reconnaissance*, 17.
[32] National Commission for the Review of the National Reconnaissance Office, *The NRO at the Crossroads*, 12.
[33] Kehler, "One Size Does Not Fit All".

divergence serves as an excellent starting point for identifying the critical variables for execution agents.

Two of the objectives listed by General Kehler—the objectives of content and focus—do indeed differ in scope between decision makers and execution agents, but these differences are not substantial enough to qualify these objectives as critical. Given the global perspective that space provides to all users and the resultant relative benefit imparted by space systems across the objectives of adaptability, responsiveness and coverage, the content and focus of intelligence can theoretically be adjusted periodically to meet the needs of both parties. While the 2000 Independent Commission on the National Imagery and Mapping Agency was correct to highlight a growing competition for resources in system utilization—"Whereas the geography of the Soviet Union allowed for many imagery collection opportunities of mutual interest to the national and operational communities, the geography of today's adversaries and interesting intelligence targets create competition"—this competition for focus and content is not a critical variable in overall system optimization.[34]

Quality, on the other hand, is a critical variable—altering the quality output will exert a large influence on the overall system. As previously discussed, however, quality is typically a critical variable for decision makers as opposed to execution agents. Quality that meets the needs of decision makers will more often than not meet (if not exceed) the needs of execution agents.

The true critical variables for a system that optimally meets the tactical intelligence needs of execution agents are thus to be found in the remaining concepts of frequency and timeliness:

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[34] Independent Commission on the National Imagery and Mapping Agency, *The Information Edge: Imagery Intelligence and Geospatial Information in an Evolving National Security Environment*, (2000), 41.

Frequency

The concept of frequency closely parallels the objective of time-on-station as defined in Table 1—the amount of time a system can observe an area of interest. However, while time over target is a key component of the concept, the rationale for frequency as a critical variable is slightly broader than this limited scope might suggest.

To more fully understand the concept of frequency and to gain insight into the rationale for its selection as a critical variable for execution agents, it is useful to first distinguish between the concepts of surveillance and reconnaissance. These concepts are often used interchangeably and even appealing to Joint Publication 1-02, the Department of Defense Dictionary of Military and Associated Terms, does little to clarify the differences:

- "Reconnaissance: A mission undertaken to obtain, by visual observation or other detection methods, information about the activities and resources of an enemy or adversary."[35]
- "Surveillance: The systematic observation of aerospace, surface, or subsurface areas, places, persons, or things, by visual, aural, electronic, photographic, or other means."[36]

Both surveillance and reconnaissance rely on observation and the only distinction the Joint Publication makes between the two concepts is the inclusion of the term systematic to describe the type of observation that comprises surveillance.

While appearing as a minor distinction, the difference between observation and systematic observation is critical. As former undersecretary of the Air Force for space and former director of the National Reconnaissance Office, Martin C. Faga more precisely describes, "In reconnaissance you're out looking for things. You often don't know

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[35] Joint Publication (JP) 1-02, *Department of Defense Dictionary of Military and Associated Terms*, As Amended Through 31 October 2009, 453.
[36] Joint Publication (JP) 1-02, 528.

what you might find and you may look very infrequently, as infrequently as every few years at a given area."[37] On the other hand, "in surveillance, which is what the military is most interested in, it is systematic observation, typically frequent, even persistent. The idea that I already understand the landscape but I want to look at it every month, every week, every day, or every hour, depending on the situation."[38]

Former Undersecretary Faga neatly distinguishes between reconnaissance and surveillance. More importantly, however, he concisely captures the link between frequency and surveillance. To perform systematic observation requires frequent, even persistent examination of an area of interest. It is this reliance on frequent observations that separates surveillance from reconnaissance and ultimately drives execution agents'—whose activities are tied to the actionable intelligence that flows from surveillance—greater reliance on frequency.

The fact that execution agents rely more on surveillance than reconnaissance, and therefore have greater need for frequency than decision makers is supported by current space and intelligence leaders. Mr. Joseph Rouge the director of the National Security Space Office claims "the real issue is persistence" and suggests enough persistence is needed to see and know "when something changes."[39] In contrasting execution agents' needs with those of decision makers, General Deptula states, "I'm constantly thinking about the value of what space can provide to the warfighter, the Combatant Commander…I don't need exquisite to be able to determine what's going on."[40] He goes on to state that rather than exquisiteness, a more important need for the warfighter

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[37] Martin C. Faga, interview by the author, 24 February 2010, Tysons Corner, VA. Audio recording in author's personal archives.
[38] Faga, interview.
[39] Joseph Rouge, interview by the author, 22 February 2010, Pentagon, VA. Notes in author's personal archives.
[40] Lieutenant General David A. Deptula, interview by the author, 23 February 2010, Pentagon, VA. Audio recording in author's personal archives.

is persistence.[41] In short, the execution agent's mission requires surveillance; surveillance in turn requires frequent observation or possibly persistence. Frequency thus surfaces as one critical variable for system optimization in support of execution agents.

Timeliness

As General Kehler correctly captured, a second critical variable for execution agents is that of timeliness.[42] While this objective is closely related to frequency, it differs enough to be captured separately. Whereas frequency dealt with a relationship between the observation platform and the object or area of interest, timeliness is a measure of the time relationship between the information and the end user. It is similar to the previously defined objective of time-to-think—the amount of time a system allows for orienting.

The very nature of tactical intelligence makes the criticality of this objective to execution agents quite straightforward. Remembering that the goal of tactical intelligence is to "support effective national security action" by delivering "actionable intelligence to support diplomats, military units, interagency organizations in the field, and domestic law enforcement organizations at all levels," the need for that actionable intelligence to arrive in a timely manner is self-evident.[43] Figure 2, as presented by the National Commission for the Review of the National Reconnaissance Office, highlights different timeliness requirements. The tactical user needs information in seconds to days in order to execute a successful mission. The strategic user, who is not seeking to act but rather to understand, has the flexibility of more time. As a result, timeliness must be captured as a second critical variable for execution agents' system optimization.

[41] Deptula, interview.
[42] Kehler, "One Size Does Not Fit All".
[43] *The National Intelligence Strategy of the United States of America*, 5.

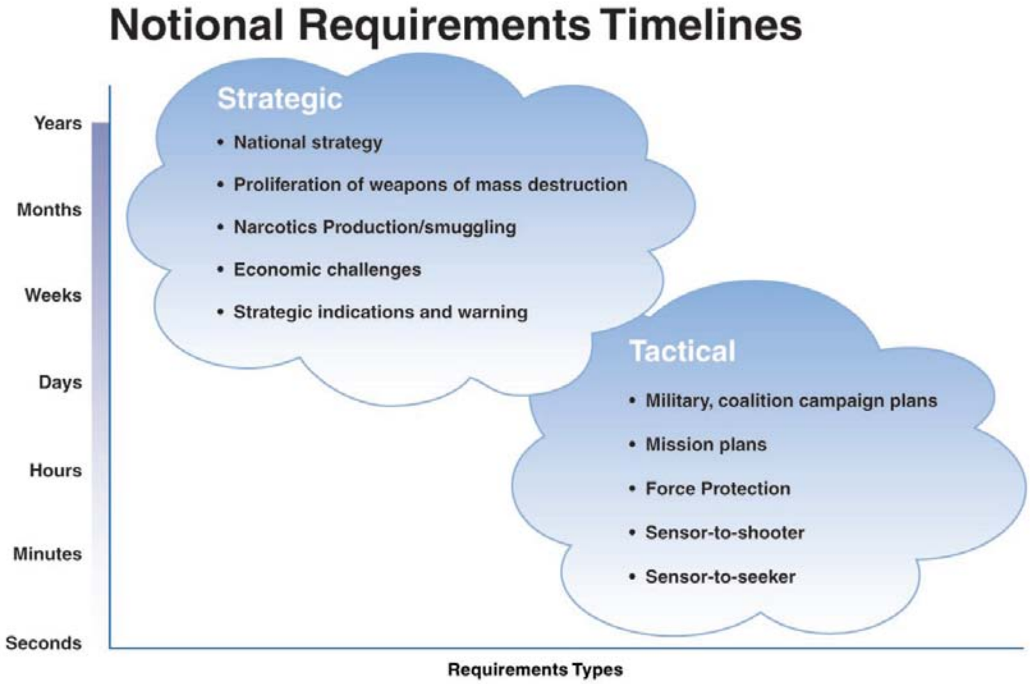

Figure 2: Strategic vs. Tactical Timeliness Differences
Source: From The NRO at the Crossroads. Report of the National Commission for the Review of the National Reconnaissance Office, Washington, DC, 2000, p49.

Continuing Support

One final critical system variable must be considered. While execution agents need timely and frequent information from space assets, even a system of persistent overhead coverage from which flowed real-time actionable intelligence would lack one critical characteristic for those executing national strategy—the guaranteed, continued existence of the needed information. General Kehler captures this critical variable with the phrase "continuing support": "Military purposes demand space systems that provide timely and *continuing support* to joint force commanders (emphasis added)."[44] The concept of continuing support denotes the execution agent's need for guaranteed access to required information even in the face of internal resource competition or external

[44] C. Robert Kehler, "2008 Global Warfare Symposium Keynote" (Address, Global Warfare Symposium, Beverly Hills, CA, 21 Nov 2008).

conflict. When coupled with timeliness and frequency, continuing support completes the set of critical variables for execution agents.

The rationale for including continuing support in the critical variable set derives from the missions and timelines against which execution agents must act. While the campaign planning, force protection, or sensor-to-shooter missions captured in the tactical portion of Figure 2 are of no greater value than the strategic missions of national strategic planning, non-proliferation, or counter-narcotics, the consequence to the tactical missions of vanishing or sporadic ISR support certainly is. A strategic decision maker whose needed information fails to materialize will have the option to wait for another opportunity or to seek the information elsewhere. The execution agent, however, whose actions are on a shorter timeline, will likely not have other opportunities or mechanisms from which to obtain the needed information. In short, any system that seeks—as the Joint Space Operations Center claims to seek—to "integrate space power into global military operations," must include guaranteed, continuing support to those operations as a critical variable against which the system can be optimized.[45]

The implications of this conclusion are two-fold. First, execution agents require "assuredness of capability."[46] While the nature of the high-ground of space provides relative system security, there is growing consensus that concludes, as did the 2008 *Report to Congress of the Independent Assessment Panel on the Organization and Management of National Security Space*, that "the progress in addressing the vulnerability of U.S. space assets has not kept pace with growing threat capabilities."[47] The vulnerability the nation faces encompasses more

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[45] Raymond Hoy, "Joint Space Operations Center," *Military Space & Missile Forum* 2, no. 3 (2009).
[46] Kehler, "2008 Global Warfare Symposium Keynote".
[47] A. Thomas Young et al., *Leadership, Management and Organization for National Security Space*, (Alexandria, VA: Institute for Defense Analyses, 2008), 24.

than the risk that a system might "suffer a loss of capability"—the survivability objective.[48] This broader vulnerability relates to the level of integration space-based overhead reconnaissance has received in the missions of execution agents. Space has become "inextricably woven into the fabric of… national security."[49] While for many nations, space has been used simply as "crucial force multiplier," for the United States, space usage has gone "well beyond this and (become) a force enabler."[50] To counter this vulnerability, the consolidated concept of capability assuredness as captured by the objectives of survivability, surge, replacement, and sustainment must form a significant portion of the broader objective of continued support.

A second implication of continuing support's inclusion as a critical variable is that execution agents require "assuredness in tasking."[51] This concept addresses assured access from an internal, as opposed to external, perspective, and fulfillment of this objective hinges upon perception. As General Kehler suggests, "If they perceive the tasking won't compete well within somebody else's priorities, then many times warfighters won't ask for it."[52] If execution agents lack confidence in their ability to receive continued, assured support from the overhead ISR system, the system has not been optimized to meet their needs. While this need is often interpreted as control, Lieutenant General Deptula clarifies that this does not have to be the case, "I'm less concerned with control than I am access…if I'm getting product I'm happy."[53] Ensuring warfighters and others continue to "get product" is the ultimate objective of the final critical variable of execution agents—continuing support.

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[48] Deptula, *Lead Turning the Future: The 2008 Strategy for United States Air Force Intelligence, Surveillance and Reconnaissance*, 20.
[49] Michael Sheehan, *The International Politics of Space*, Space Power and Politics (New York: Routledge, 2007), 117.
[50] Sheehan, *The International Politics of Space*, 108.
[51] Kehler, "2008 Global Warfare Symposium Keynote".
[52] Kehler, "2008 Global Warfare Symposium Keynote".
[53] Deptula, interview.

Conclusion

The fundamental purpose of all intelligence activity is the derivation of knowledge from which subsequent decision or action can be driven. Optimizing an overarching intelligence, surveillance, and reconnaissance (ISR) system to achieve this purpose requires meeting the needs of both decision makers and execution agents whose precise areas of emphasis differ. As the ultimate high ground space provides both parties relative advantages in the areas of coverage, access, and inaccessibility. While important, optimizing a system for these universal domain benefits will achieve less than optimizing for the critical variables—those whose variation exerts major influence on the resultant shape of the system. The most important critical variable for decision makers is exquisite intelligence provided by inconceivable methods. The needs of execution agents center upon frequency, timeliness and guaranteed, continued support. Table 2 summarizes the ISR objectives illuminated in this chapter. Understanding the components and characteristics of the existing system and assessing those components and characteristics against these critical variables is the task to which this effort now turns

Table 2 Critical Variables for Decision Makers & Execution Agents

Decision Makers	Execution Agents
Exquisiteness	Frequency
Inconceivability	Timeliness
	Guaranteed, Continued Support

Source: Author's Original Work

Chapter 3

System Components

> *The assertion that we should (and could) combine requirements on a small number of large, complex, long-lived satellites has been our fundamental strategic approach for many years. That strategy assumed and demanded close integration between the Department of Defense and the Intelligence Community; "white" and "black" space.*
>
> *General Robert C. Kehler*
> *Commander, Air Force Space Command*

"The primacy of developing reconnaissance satellites and ensuring that these satellites enjoyed freedom of overflight" became, as Mark Erickson indicates, "the guiding principle" of early American space efforts.[1] As a result of this primacy, early national efforts in space focused upon developing an overarching system to perform the overhead intelligence mission. The resultant system, characterized by both organizations and orbital platforms, had a "crucially important role" for over four decades in "preserving the national security interests of the United States."[2]

This study seeks to assess the optimality of the current system in performing its "crucially important role" today.[3] Having previously identified the objectives an overhead ISR system must achieve, the focus of this study now turns to understanding the nature of the system itself. To what extent have the organizations and technical systems that for decades filled such an important role remained the same? To what extent have they changed? Have new system elements been introduced,

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[1] Mark A. Erickson, "Reconnaissance and Prestige: The Creation of a Trinitarian U.S. Space Program," in *Harnessing the Heavens: National Defense through Space*, ed. Paul G. Gillespie and Grant T. Weller (Chicago: Imprint Publications, 2008), 49.
[2] National Commission for the Review of the National Reconnaissance Office, *The NRO at the Crossroads*, (Washington, DC, 2000), 1.
[33] National Commission for the Review of the National Reconnaissance Office, *The NRO at the Crossroads*, 1.

thereby modifying the nature of the system? Understanding the primary overhead ISR system components, their evolution, and ultimately, their current nature, is the purpose of this chapter.

System Components Development: Black & White Space Separation

The early development and growth of a national overhead ISR system has been well documented by many including Burrows, Richelson, Temple, and Spires.[4] Capturing the full extent of the political struggle that led to the development of surveillance and reconnaissance satellites under, as Spires has assessed, "fragmented" rather than "unified, closely integrated" control is beyond the scope of this work.[5] The resultant system and the rationale for such a solution are extremely pertinent to a discussion of strategic optimization, however. Briefly illuminating the purposes against which overhead ISR systems and organizations were created serves to enlighten the assessment of existing systems against present day objectives.

The initial impetus for intelligence collection from space can be traced to the Technological Capabilities Panel (TCP) chaired by James R. Killian, Jr. in 1955, referenced previously. Deemed to be one of the "seminal documents of the Cold War and certainly of American military space policy," the TCP's final report laid the foundation of strategic space policy for "years to come."[6] The panel concluded: "We must find ways to increase the number of hard facts upon which our intelligence estimates are based, to provide better strategic warning, to minimize surprise in

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[4] For example see William E. Burrows, *Deep Black: Space Espionage and National Security* (New York: Random House, 1986), Jeffrey T. Richelson, *America's Secret Eyes in Space: The U.S. Keyhole Spy Satellite Program* (New York: Harper & Row, 1990), L. Parker Temple, III, *Shades of Gray: National Security and the Evolution of Space Reconnaissance* (Reston, VA: American Institute of Aeronautics and Astronautics, 2005), and David N. Spires, *Beyond Horizons: A Half Century of Air Force Space Leadership* (Washington, DC: Air Force Space Command in association with Air University Press, 1998).
[5] Spires, *Beyond Horizons: A Half Century of Air Force Space Leadership*, 53.
[6] Erickson, "Reconnaissance and Prestige: The Creation of a Trinitarian U.S. Space Program," 50.

the kind of attack, and to reduce the danger of gross overestimation or gross underestimation of the threat. To this end, we recommend adoption of a vigorous program for the extensive use…of the most advanced knowledge in science and technology."[7]

The efforts that derived from such a broad policy assessment were, understandably, equally wide-ranging. Military services pursued simultaneous, and at times duplicative, projects as each sought to win the developing "fierce contest for control of (space) roles and missions."[8] Specific to overhead ISR systems, the Air Force awarded a 1956 contract for development of the WS-117L system—a project that originally sought to return imagery to earth via radio transmission and evolved to a film capsule return system.[9] The Army countered with a 1957 proposal to develop a system of their own.[10] As a result of continued inter-service rivalry, when the National Security Council assigned "highest priority status to the development of an operational reconnaissance satellite" in January 1958, the fundamental question of who should lead the effort remained unresolved.[11]

Ultimately the inter-service debate proved costly to both Air Force and Army bids to seize control and became a driving factor for the resultant separation of what has become known as black and white space. In February 1958, following the recommendation of his advisors, President Eisenhower decided neither service should lead the development of an operational photographic reconnaissance satellite. The President, as Temple claims, "wanted the space reconnaissance effort conducted covertly, just like the U-2"—a Central Intelligence Agency (CIA) led procurement—and therefore pushed for CIA

[7] Quoted in Erickson, "Reconnaissance and Prestige: The Creation of a Trinitarian U.S. Space Program," 50.
[8] Spires, *Beyond Horizons: A Half Century of Air Force Space Leadership*, 49.
[9] Curtis Peebles, *Guardians: Strategic Reconnaissance Satellites* (Novato, CA: Presidio Press, 1987), 45.
[10] Richelson, *America's Secret Eyes in Space: The U.S. Keyhole Spy Satellite Program*, 24.
[11] Richelson, *America's Secret Eyes in Space: The U.S. Keyhole Spy Satellite Program*, 26.

involvement.[12] While the satellite development program, which became known as CORONA, was ultimately designated as a joint CIA-Air Force effort, the decision to include the CIA became a critical first step in establishing the future bifurcated nature of national security space.[13]

Organizational Component #1: Black Space/The NRO

The joint CIA-Air Force program established by Eisenhower operated, as described by former NRO historian Gerald Haines, "under a loose, unstructured arrangement."[14] While this unstructured relationship worked well "for a time," science advisor George Kistiakowsky states that it ultimately led to "administrative chaos" and "technical troubles."[15] In short, Peebles concludes, the informal nature of the CIA and Air Force relationship "did not work well" and "sparked several months of arguments between the White House, Department of Defense, Air Force, and CIA."[16] The president was ultimately forced to step in and, in 1960, ordered the secretary of defense to "recommend an overall management scheme…for reconnaissance satellites."[17]

While importantly concluding that "space reconnaissance was absolutely vital to U.S. national security," the report of the three-person group appointed by the secretary of defense to assess satellite reconnaissance contained two additional findings that would further the divide between black and white space.[18] First, the group recommended that reconnaissance satellites represented national assets and should be

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[12] Temple, *Shades of Gray: National Security and the Evolution of Space Reconnaissance*, 142.
[13] Spires, *Beyond Horizons: A Half Century of Air Force Space Leadership*, 71.
[14] Quoted in Erickson, "Reconnaissance and Prestige: The Creation of a Trinitarian U.S. Space Program," 56.
[15] Quoted in Erickson, "Reconnaissance and Prestige: The Creation of a Trinitarian U.S. Space Program," 56.
[16] Peebles, *Guardians: Strategic Reconnaissance Satellites*, 58.
[17] Erickson, "Reconnaissance and Prestige: The Creation of a Trinitarian U.S. Space Program," 56.
[18] William E. Burrows, *This New Ocean: The Story of the First Space Age* (New York: Random House, 1998), 238.

directed by a civilian agency, not by a military service.[19] Second, the group advocated space reconnaissance programs should be conducted in "total secrecy."[20]

The result of these two recommendations was the creation of a secretive, new, national level organization—the Office of Missile and Satellite Systems which, a short time later in 1961 became the National Reconnaissance Office (NRO).[21] The job of this organization would be to covertly "buy and operate the nation's spy satellites."[22] Simultaneous with the stand-up of this new organization, the president issued a directive establishing "a new and entirely separate security classification system for reconnaissance satellites."[23] Taken together, these actions drove, according to Burrows, a "complete security clampdown" which turned the operation quickly from "dark gray" to "deep black."[24]

While creation of a new classified organization served its intended purpose—covert reconnaissance satellites successfully overflew the Soviet Union for more than three decades—the new organization had the secondary effect of further separating black and white space. While the new office was directed by the undersecretary of the Air Force, Spires correctly highlights that "Air Force headquarters was essentially excluded from the operations of this highly sensitive national project."[25] Ultimately, the creation of the NRO ended "any pretense of direct Air Force control of space reconnaissance."[26] From 1961 onwards, the

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[19] Spires, *Beyond Horizons: A Half Century of Air Force Space Leadership*, 85.
[20] Burrows, *This New Ocean: The Story of the First Space Age*, 238.
[21] Erickson, "Reconnaissance and Prestige: The Creation of a Trinitarian U.S. Space Program," 57.
[22] Burrows, *This New Ocean: The Story of the First Space Age*, 239.
[23] Erickson, "Reconnaissance and Prestige: The Creation of a Trinitarian U.S. Space Program," 57.
[24] Burrows, *This New Ocean: The Story of the First Space Age*, 239.
[25] Spires, *Beyond Horizons: A Half Century of Air Force Space Leadership*, 85.
[26] Burrows, *This New Ocean: The Story of the First Space Age*, 239.

military satellite reconnaissance program has operated “outside the Air Force area of responsibility.”[27]

Organizational Component #2: White Space/ AF Space Command

The loss of control of a space mission called by Spires, “one of its largest and most important,” did not lead the Air Force to totally abandon space.[28] Instead, the Air Force pursued and was ultimately awarded responsibility for “research, development, test, and engineering of Department of Defense space development programs and projects.”[29] As Spires has captured, the 1961 decision by the secretary of defense to make the Air Force the “lead military service in space,” represented “a major step in the Air Force’s quest for the military space mission.”[30] The decision also represented a major step in solidifying an organizational construct founded on two separate and distinct national security space organizations.

The Air Force took an additional organizational step in that direction with the formation of Air Force Space Command in September 1982.[31] Driven by a “growing dependence on space, the evolving threat from the Soviet Union, the growing space budget and a perceived need to ‘operationalize’ space,” the creation of a formalized command structure for military space strengthened the divide between national reconnaissance and military space programs.[32] As General Hartinger, who served as the first commander, explained, the new command would provide “a focus for centralized planning, consolidated requirements” and serve as “an operational advocate and honest broker for *USAF space*

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27 Spires, *Beyond Horizons: A Half Century of Air Force Space Leadership*, 85.
28 Spires, *Beyond Horizons: A Half Century of Air Force Space Leadership*, 84.
29 Spires, *Beyond Horizons: A Half Century of Air Force Space Leadership*, 89.
30 Spires, *Beyond Horizons: A Half Century of Air Force Space Leadership*, 89.
31 Air Force Space Command, "AFSPC Chronology," http://www.afspc.af.mil/heritage/chronology.asp.
32 Commission to Assess United States National Security Space Management and Organization, *Report of the Commission to Assess United States National Security Space Management and Organization*, (Washington, DC: Department of Defense, 11 January 2001), 57.

systems (emphasis added)."[33] The NRO—a separate and distinct organization—remained the advocate and broker for national space systems.

Importantly, while the space systems under Air Force Space Command control did not include the space-based reconnaissance satellites on which the Air Force and other warfighters ultimately came to "rely for precision, targeting, location and battlespace awareness," the Air Force continued efforts to pursue other aspects of the overhead ISR mission.[34] Having ceded the reconnaissance mission to national control, the Air Force maintained direction of the strategic warning or surveillance mission through programs which postured to provide near-real time surveillance data to execution agents should war erupt. The Missile Defense Alarm System (MIDAS), designed to detect the launch of ballistic rockets, and the Vela Hotel program, designed to detect nuclear detonations in outer space, led the way in the surveillance mission.[35] These programs evolved into the Defense Support Program (DSP) and the Integrated Operational Nuclear Detonation Detection System (IONDS), both of which became "central components" in the nation's global missile warning—i.e. surveillance—mission under Air Force control.[36]

The Nature of the Components Evolves

In the era of the Cold War, having separate organizations—black and white space—with, as former NRO Director Martin Faga indicates, "clear lanes in the road," was not only functionally acceptable but actually proved quite successful.[37] The Department of Defense, led by

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[33] Quoted in Spires, *Beyond Horizons: A Half Century of Air Force Space Leadership*, 205.
[34] Commission to Assess United States National Security Space Management and Organization, *Report of the Commission to Assess United States National Security Space Management and Organization*, 55.
[35] Peebles, *Guardians: Strategic Reconnaissance Satellites*, 306, 331.
[36] Spires, *Beyond Horizons: A Half Century of Air Force Space Leadership*, 154.
[37] Martin C. Faga, interview by the author, 24 February 2010, Tysons Corner, VA. Audio recording in author's personal archives.

Air Force Space Command and its predecessors, “crafted a variety of orbital platforms to meet military requirements in space,” including the surveillance mission.[38] The NRO developed and operated systems that, as General Kehler proposes, “primarily reflected national reconnaissance purposes as established by the intelligence community.”[39] As Burrows accurately emphasizes, establishing the NRO did not put an end to the “rivalries between competing agencies and military services” as hoped.[40] However, despite those continued rivalries, the pursuit of defined space efforts by separate space organizations did not hinder the “crucially important role” the Commission for Review of the NRO found that space assets played in “providing American Presidents a decisive advantage in preserving the national security interests of the United States.”[41] Erickson concurs: “In the final analysis, the…American space program…made a vital contribution to America’s ultimate political/ideological and technological victory in the Cold War.”[42]

Despite this historical success, two events changed the role of space assets and the nature of the components that comprise the national security space system—ultimately shifting the nation away from a strategy that proved successful for decades. First, the Cold War ended and collection targets proliferated. The NRO Commission assessed that “during its early years, the NRO was primarily involved in developing first-of-a kind satellite systems…for the most part focused against a

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[38] Erickson, "Reconnaissance and Prestige: The Creation of a Trinitarian U.S. Space Program," 49.

[39] C. Robert Kehler, "2008 Global Warfare Symposium Keynote" (Address, Global Warfare Symposium, Beverly Hills, CA, 21 Nov 2008).

[40] William E. Burrows, "Satellite Reconnaissance," in *The Intelligence Revolution and Modern Warfare*, ed. James E. Dillard and Walter T. Hitchcock (Chicago: Imprint Publications, 1996), 195.

[41] National Commission for the Review of the National Reconnaissance Office, *The NRO at the Crossroads*, 1.

[42] Erickson, "Reconnaissance and Prestige: The Creation of a Trinitarian U.S. Space Program," 59.

single intelligence target—the Soviet Union and the Warsaw Pact."[43] In many senses, developing reconnaissance systems to collect intelligence against a known enemy proved easier than pursuing reconnaissance in the multi-polar world that followed the end of the Cold War.

Second, the Gulf War demonstrated an expanding role for space-based systems. National reconnaissance systems, as evaluated by David Lindgren, "were never designed to detect the location of fighting vehicles in real time or provide bomb damage assessments in a matter of hours."[44] However, during the Gulf War the NRO demonstrated that these systems could "respond to changes in battlefield conditions" and, in so doing, whet the war-fighters' appetite for space-based tactical reconnaissance.[45] Former NRO Director, Keith Hall suggests that prior to the Gulf War, "the military had not trained or equipped to make significant use of data from national assets"—a clear result of separate organizations and separate lanes in the road.[46] The value these systems added during the Gulf War showed the importance of tighter integration, and the "constant need" created by "having troops in harm's way since 1994" led the military to "begin in earnest" to integrate national and military capabilities.[47]

Black Becomes White

The combined impacts of the ending of the Cold War and associated increase in tactical use of national reconnaissance systems brought about by the Gulf War drove significant changes to the nature of the National Reconnaissance Office and the national security space system. While the NRO remained, as assessed by the 1996 panel that

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[43] National Commission for the Review of the National Reconnaissance Office, *The NRO at the Crossroads*, 22.
[44] David T. Lindgren, *Trust but Verify: Imagery Analysis in the Cold War* (Annapolis, MD: Naval Institute Press, 2000), 185.
[45] Lindgren, *Trust but Verify: Imagery Analysis in the Cold War*, 185.
[46] Keith Hall, interview by the author, 25 February 2010, Herndon, VA. Notes in author's personal archives.
[47] Hall, interview.

sought to define the organization's future, "first and foremost an intelligence organization," the scope of intelligence, as defined by the number of users, rapidly expanded.[48] Even in 2010 the NRO's internet homepage still acknowledges that NRO products are being provided to "an expanding list of customers."[49] The once clear lane in the road has been replaced with a system in which the NRO must operate via "extensive negotiations among a wide variety of strategic and tactical customers."[50]

The proliferation of masters drove a second significant change to the nature of the NRO. In order to support distribution of national reconnaissance data to "a wide variety of users in many U.S. Government agencies," the "existence of the NRO" and "several aspects of its activities" were declassified in 1992.[51] This declassification, driven by a high cost of security that appeared to be "inappropriate for the post-Cold War" as well as lessons learned from DESERT STORM which "further enhanced the attractiveness" of the option, reversed the Killian panel's earlier recommendation for secrecy and further blurred the distinction between black and white space.[52]

Finally, not only did the number of users increase, driving changes to the NRO's nature, but the composition of those users also changed dramatically, having a similarly significant effect. As Alden Munson, Deputy Director of National Intelligence for Future Capabilities succinctly summarized at a 2009 space policy symposium, systems that once were used to satisfy customers "primarily inside the Washington Beltway" now had to be developed and operated to "meet many different masters and

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[48] Jeremiah Panel, *Defining the Future of the NRO for the 21st Century*, 8.
[49] National Reconnaissance Office, "NRO Homepage," http://www.nro.gov/.
[50] National Commission for the Review of the National Reconnaissance Office, *The NRO at the Crossroads*, 38.
[51] National Commission for the Review of the National Reconnaissance Office, *The NRO at the Crossroads*, 21.
[52] Temple, *Shades of Gray: National Security and the Evolution of Space Reconnaissance*, 555.

many different requirements."[53] Increasing the user base to include world-wide execution agents, not just decision makers inside the beltway, naturally shifted focus away from "developing first-of-a kind satellite systems" and towards ensuring continued "operation of…large mainstay systems."[54] This focus on operations and the continued effort to make systems "more applicable to tactical commanders" moved the NRO even closer to the traditional role of white space.[55]

White Becomes Black

Air Force Space Command—white space—also experienced a shift towards the center in the post-Cold War era as the surveillance mission of strategic missile warning experienced an expansion of users and a blurring of mission lanes. Driven by a "much better-quality IR sensor" with "higher fidelity capability" to detect "not only missiles, but also other lower intensity IR events," Air Force Space Command has also experienced an increase in number and composition of their ISR user base.[56] The result has been a shift from a surveillance platform to a combined surveillance and reconnaissance platform, as the new Space-Based Infrared System (SBIRS) program sought to provide not only "enhanced worldwide missile detection and tracking capabilities" but also "battlefield data", and "technical intelligence."[57] While detailing the full extent of the SBIRS program is outside the scope of this assessment of overhead imagery reconnaissance strategies, the program serves to highlight the evolving role for Air Force Space Command (AFSPC) in the ISR arena. As Kehler states, AFSPC is "in fact improving…space ISR as

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[53]Quoted in Dwayne Day, "Space Policy 101: Military Space 2009," *The Space Review* (15 June 2009), http://www.thespacereview.com/article/1397/1.
[54] National Commission for the Review of the National Reconnaissance Office, *The NRO at the Crossroads*, 26.
[55] Spires, *Beyond Horizons: A Half Century of Air Force Space Leadership*, 210.
[56] Marty Kauchak, "Q&A: Lieutenant Larry D. James," *Military Space & Missile Forum* 2, no. 6 (2009).
[57] Lockheed Martin, "Space Based Infrared System - High (SBIRS High)," http://www.lockheedmartin.com/products/SpaceBasedInfraredSystemHigh/index.html.

well. That's what SBIRS is all about."[58] As they do so, the lines between black and white space become further blurred.

Organizational System Components Today

The preceding discussion serves to illuminate the current nature of the two primary organizational components of the nation's overhead imagery ISR strategy. The evolution of national security space over the last sixty years has left the nation with two primary space ISR organizations—the National Reconnaissance Office (NRO) and Air Force Space Command. While distinct in chains and span of control, these organizations are no longer distinct in mission or purpose. The NRO's formal mission statement is to provide "innovative overhead intelligence systems for national security."[59] While subtle differences can be found, distinguishing this mission from that of Air Force Space Command—"provide an integrated constellation of space and cyberspace capabilities at the speed of need"—is not straightforward.[60] Fundamentally both organizations seek to design, acquire and operate *space systems* which provide needed *information* to tactical and strategic users in support of national security objectives. The following chapters assess whether or not the organizational solution to which the nation has evolved—having distinct organizations with overlapping missions—optimally meets the objectives of overhead ISR.

The Traits of Current Technical Systems

Beyond a discussion of primary organizations within the overhead ISR system, one additional set of system components must be illuminated before an assessment of overall system optimality can proceed—the technical systems themselves. While any long term effort to

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[58] C. Robert Kehler, "2009 Global Warfare Symposium Keynote" (Address, Global Warfare Symposium, Beverly Hills, CA, 20 Nov 2009).
[59] National Reconnaissance Office, "NRO Homepage."
[60] Air Force Space Command, "AFSPC Homepage," http://www.afspc.af.mil/.

optimize the national overhead ISR system would certainly involve the introduction of new technical systems (i.e. new satellites), understanding the existing system's traits is useful in assessing the current degree of optimality.

Importantly, the following assessment will focus on *traits* of the existing system—not specific technical details. This focus is intentional. First, the constraint of security prevents a discussion of existing systems beyond rough generalities. While the existence of the NRO was declassified in 1992, the details of existing systems have rightly retained their classified status. Second, even if specific technical details of current overheard ISR platforms were available, their inclusion here risks devolving the discussion to the tactical as opposed to the strategic. Generalities are more than sufficient—and actually preferred—for assessing the current system against the high level critical variables introduced in the previous chapter.

Trait #1: Few in Number

In his assessment of the international politics of space, Professor Michael Sheehan succinctly summarized the first trait of the current overhead ISR system: "The United States has tended to launch a small number of large, highly effective satellites, which remain in orbit for long periods."[61] This is to be contrasted, for example, with the approach of the Soviet Union which Sheehan found preferred to launch satellites with "much shorter periods in orbit" and therefore launched "much larger numbers in order to gain some degree of global coverage."[62]

In his controversial 1986 work, *Deep Black,* Burrows attempted to peer into the, then, extremely murky world of space espionage and national security.[63] Near the conclusion of his work Burrows estimates

[61] Michael Sheehan, *The International Politics of Space*, Space Power and Politics (New York: Routledge, 2007), 92.
[62] Sheehan, *The International Politics of Space*, 92.
[63] Burrows, *Deep Black: Space Espionage and National Security*.

that the combination of the January 1986 space shuttle disaster and a subsequent April 1986 launch failure of a Titan rocket carrying an NRO imaging satellite left only one KH-11 imaging satellite on orbit.[64] The result was a gap in capability—a "real crisis" according to Paul Stares of the Brookings Institution.[65] With access to more open-source information in 2000, Lindgren assesses that two KH-11 imaging satellites (a "single new advanced KH-11 and an additional aging KH-11") were available during this period.[66] Whether Burrows or Lindgren is correct, the point remains that US imagery satellites tend to be few in number—a point that was exacerbated by launch failures during the 1980s.

Failures also appear to be driving a potential gap in the current imagery collection system. While these current failures are programmatic rather than technical, the resultant discussion of potential gaps in capability serves as an indication that the current system remains small in number. In 2009, Director of National Intelligence Dennis Blair said in a press statement, "When it comes to supporting our military forces and the safety of Americans, we cannot afford any gaps in collection. We are living with the consequences of past mistakes in acquisition strategy…"[67] Blair's deputy director, Al Munson, has also spoken publicly about the "fragility" of the current constellation—further evidence that current system numbers are few.[68]

While speculative and unverifiable, Dwayne Day of the National Academy of Sciences and frequent contributor to *The Space Review*, a website dedicated to providing "a deeper examination of key space issues, events, history, and related topics" provides additional evidence to

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[64] Burrows, *Deep Black: Space Espionage and National Security*, 305.
[65] Quoted in Burrows, *Deep Black: Space Espionage and National Security*, 305.
[66] Lindgren, *Trust but Verify: Imagery Analysis in the Cold War*, 166.
[67] Colin Clark, "President Approves New Spy Satellites," *DoD Buzz: Online Defense and Acquisition Journal* (7 April 2009), http://www.dodbuzz.com/2009/ 04/07/president-approves-new-satellite-system/.
[68] Quoted in Ben Iannotta and Gayle S. Putrich, "Spy-sat Rescue," *C4ISR Journal* 8, no. 5 (2009): 20.

support this claim.[69] Table 3 summarizes his assessment of the launch dates of the various KH-11 satellites.[70] Even assuming Sheehan is correct and these systems "remain in orbit for long periods," it is unlikely that more than four spacecraft currently remain in operations.[71] For comparison consider the Hubble Telescope. Launched in 1990 with a stated mission duration of 20 years, it has required five servicing missions to continue operations to date.[72] By interpolation, the data provided by Day supports the conclusion that at any given time the nation has a relatively low number of overhead imagery systems on-orbit.

Table 3: Speculative Launch Dates of US KH-11 Imagery Systems

Number	Launch Date	Designation	Notes
1	19 Dec 1976	1976-125A	Block 1
2	14 June 1978	1978-060A	Block 1
3	7 Feb 1980	1980-010A	Block 1
4	3 Sep 1981	1981-085A	Block 1
5	18 Nov 1982	1982-111A	Block 1
6	4 Dec 1984	1984-122A/USA 6	Block 2
7	28 Aug 1985	LAUNCH FAILURE	Block 2
8	26 Oct 1987	1987-090A/USA 27	Block 2
9	6 Nov 1988	1988-099A/USA 33	Block 3
10	28 Nov 1992	1992-083A/USA 86	Block 3
11	5 Dec 1995	1995-066A/USA 116	Block 3
12	20 Dec 1996	1996-072A/USA 129	Block 3
13	5 Oct 2001	2001-044A/USA 161	Block 4
14	19 Oct 2005	2005-042A/USA 186	Block 4

Source: From Dwayne Day, "Gum in the Keyhole," The Space Review, 22 June 2009.

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[69] Jeff Foust, "About the Space Review," http://www.thespacereview.com/about.html.
[70] Dwayne Day, "Gum in the Keyhole," *The Space Review* (22 June 2009), http://www.thespacereview.com/article/1400/1.
[71] Sheehan, *The International Politics of Space*, 92.
[72] Hubblesite.org, "Hubble Essentials: Quick Facts," http://hubblesite.org/the_telescope/hubble_essentials/quick_facts.php.

Trait #2: Broad in Scope

The small number of on-orbit spacecraft leads directly to a second key trait of the overhead ISR system—to support a broad variety of missions via a small number of on-orbit platforms, these platforms must be expansive in both capability and scope. Sheehan captured this concept through his assessment that the United States has tended to favor "large, highly effective satellites."[73] His assessment is supported by Joshua Hartman, former senior adviser to the US undersecretary of defense for acquisition, technology and logistics. Hartman claims, "With a trend starting in 1970, (the nation has) moved from acquiring multiple single-mission, low-cost systems to mega-sensor acquisitions that produce one-size-fits-all capability."[74]

The trend towards design of mega-sensor platforms as outlined by Hartman ties directly to Kehler's claim that began this work—"reconnaissance satellites have been designed, built, and operated to meet the requirements of both the national intelligence community and the joint force commanders."[75] The decision to launch "a few giant imaging satellites"—satellites which according to Senator Chris Bond cost "more than (the nation) paid for the last Nimitz class aircraft carrier"—has forced an associated balancing of missions.[76] This balancing of missions, in turn, has directly impacted spacecraft design and technical scope. Note the NRO Commission's acknowledgement of this impact: "The Commission believes that ensuring a proper balance between strategic and tactical requirements—in terms both of the use of

[73] Sheehan, *The International Politics of Space*, 92.
[74] Joshua Hartman, "Adapting to Succeed in Space Intel," *Defense News* (5 October 2009), http://www.defensenews.com/story.php?i=4307554.
[75] C. Robert Kehler, "One Size Does Not Fit All" (Address, GEOINT 2008 Symposium, Nashville, TN, 30 Oct 2008).
[76] Iannotta and Putrich, "Spy-sat Rescue."

current NRO systems and of *the design* of future NRO systems—is a matter of utmost national security importance (emphasis added)."[77]

The specific technical specifications resulting from a balanced, broad-based design process are, expectedly, unavailable in the public domain. Other satellite programs, however, provide useful insight into the approach. As referred to previously, the SBIRS program was created as a replacement to DSP performing a missile warning mission. The increased user set drove a larger mission set, however, and the SBIRS spacecraft were designed not only to perform missile warning but also, Missile Defense (MD), Technical Intelligence (TI), and Battle Space Awareness (BA).[78] The result is a classic mega-sensor, balanced platform. The new sensors "cover short-wave infrared like its predecessor," but also include "mid-wave infrared and see-to the ground bands" ultimately allowing the spacecraft to meet a "broader set of missions as compared to DSP."[79] The breadth of mission thus drove design breadth and is representative of a similar trait for national imaging platforms.

Trait #3: Control by Committee

Multiple missions being performed by a small set of on-orbit spacecraft leads to an obvious question, as highlighted by Burrows—"Who (will) do the tasking, or assigning of targets for those satellites?"[80] The 2000 Commission for review of the National Imagery and Mapping Agency amplifies the importance of this question through their finding—"Imagery acquired from US 'National technical means' is a free good."[81]

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[77] National Commission for the Review of the National Reconnaissance Office, *The NRO at the Crossroads*, 51.
[78] Los Angeles Air Force Base, "Space Based Infrared Systems Fact Sheet," http://www.losangeles.af.mil/library/factsheets/factsheet.asp?id=5330.
[79] Los Angeles Air Force Base, "Space Based Infrared Systems Fact Sheet."
[80] Burrows, "Satellite Reconnaissance," 187.
[81] Independent Commission on the National Imagery and Mapping Agency, *The Information Edge: Imagery Intelligence and Geospatial Information in an Evolving National Security Environment*, (2000), 16.

Although the nation goes to great expense to build and launch large, shared systems, after launch, the Commission found, there is no attempt to recover sunk costs—"even operating costs for the imaging constellation, ground processing, and exploitation are not recovered."[82] In the absence of costs to users for a shared system, it is only natural that a "fierce competition to decide where to point, or task, spy satellites" and oversubscription would ensue.[83] Answering the question of control thus becomes critical in mitigating that competition in such a way as to "at least minimally satisfy the legitimate requests of several competitive bureaucracies."[84]

The nation's solution to this problem has been control by committee—a third key trait of the technical system. Richelson, who has traced the history of this committee, concludes that since 1967 a national level committee has "sorted through the varied requests of the intelligence community, military, and civilian agencies for satellite photography."[85] Known initially as the Committee on Imagery Requirements and Exploitation (COMIREX), this committee sought to answer the three basic questions with regard to establishing targets and priorities: "1) What installations/areas were to be imaged? 2) What systems were to be targeted on specific installations/areas? 3) What was to be the frequency of coverage?"[86] While the organization assigned to answer these questions has changed over time—including COMIREX, the Central Imagery Office, the National Imagery and Mapping Agency (NIMA), and most recently, the National Geospatial-Intelligence Agency

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[82] Independent Commission on the National Imagery and Mapping Agency, *The Information Edge: Imagery Intelligence and Geospatial Information in an Evolving National Security Environment*, 15.

[83] Ben Iannotta, "A Tale of Four Towers: With Reorganization, NRO Aims for Internet-like Access to Data," *C4ISR Journal* 7, no. 3 (2008).

[84] Richelson, *America's Secret Eyes in Space: The U.S. Keyhole Spy Satellite Program*, 255.

[85] Richelson, *America's Secret Eyes in Space: The U.S. Keyhole Spy Satellite Program*, 252.

[86] Jeffrey T. Richelson, *The US Intelligence Community*, 5th ed. (Boulder, CO: Westview Press, 2008), 493.

(NGA)—the approach has remained fundamentally the same.[87] Control of the limited resource is done by a "corps of trained intermediaries" whose job is to "mediate between the information needs of intelligence consumers and the tasking of collection systems"[88]

Trait #4: Short in Revolutionary Advancement

In 1976 when the first KH-11 spacecraft was launched with a real time imaging download capability, it was a truly revolutionary advancement. Since that time a variety of reasons, including the breadth of user base, replacement cost, and long on-orbit life spans, have led to a block approach in which successive designs are simply iterations of previous purchases. This approach produces an evolution of capability rather than developing revolutionary advancements. While improvements have certainly come to each block of national overheard imagery spacecraft, the relative extent to which those improvements advance beyond the cutting-edge has expectedly decreased.

This trait has received extensive focus as part of an on-going debate over a proposed new constellation of imagery satellites. In early 2009, President Obama approved a plan for developing additional satellites that are "evolutionary upgrades of spacecraft (Lockheed Martin) has been building for the U.S. National Reconnaissance Office (NRO) for decades."[89] "Essentially the fifth block upgrade to the KH-11 series," claims Dwayne Day, will "maintain the same basic design," while benefiting from some new technologies.[90] As reported by Clark, Senators Bond and Feinstein, as well as others, advocate shifting away from the

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[87] Michael A. Turner, *Historical Dictionary of United States Intelligence*, vol. 2 (Lanham, MD: Scarecrow Press, 2006), 22.
[88] Independent Commission on the National Imagery and Mapping Agency, *The Information Edge: Imagery Intelligence and Geospatial Information in an Evolving National Security Environment*, 73.
[89] Warren Ferster, "White House Imagery Plan Gains Traction in Congress," *Space News* (19 October 2009), http://www.spacenews.com/policy/ruppersberger-agreement-near-white-house-spy-satellite-plan.html.
[90] Day, "Gum in the Keyhole."

traditional approach towards "an unproven but technologically attractive" system.[91] While ultimate resolution of the debate has remained elusive, multiple Congressional staffers interviewed in February 2010 felt the debate would be resolved in favor of further evolutionary development.[92] The result of such a decision will reinforce the "workhorse" nature of the current system and further movement away from a one-time focus on the "exquisite."[93]

Trait #5: Waning Government Exclusivity

A secondary result of the decline in revolutionary advancement has been the narrowing gap between commercial and government owned imaging systems and ultimate loss of government exclusivity for these systems. In the early years of space-based reconnaissance systems, technological and cost constraints precluded all but the most powerful nation from developing and launching "national technical means."[94] As Mary Umberger has chronicled, this began to change in 1972 with the launch of the first US civilian Earth Resources Technology Satellite (ERTS).[95] From that point forward, remotely sensed imagery became "commercially available on an officially non-discriminatory basis to purchasers through the world."[96] Today, as Taylor Dinerman has captured, "Spy satellites have become so common that almost every

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[91] Colin Clark, "Spy Sat Battle Joined on Hill," *DoD Buzz: Online Defense and Acquisition Journal* (19 October 2009), http://www.dodbuzz.com/2009/10/19/spy-sat-battle-joined-on-hill/.

[92] Interviews conducted by the author with five professional Congressional Staffers, 22-24 February 2010, Washington, DC. Notes in author's personal archives. Interviews were conducted in confidentiality and the names of interviewees are withheld by mutual agreement.

[93] Ben Iannotta, "America's Spy-sat Debate," *C4ISR Journal* 8, no. 5 (2009).

[94] B.R. Inman, "Introduction," in *Commercial Observation Satellites and International Security*, ed. Michael Krepon, et al. (New York: St. Martin's Press, 1990), 3.

[95] Mary Umberger, "Commercial Observation Satellite Capabilities," in *Commercial Observation Satellites and International Security*, ed. Michael Krepon, et al. (New York: St. Martin's Press, 1990), 9.

[96] Umberger, "Commercial Observation Satellite Capabilities," 9.

medium-sized military power has at least some capability."[97] Commercial satellite imagery is now literally accessible "around the globe."[98]

While the impacts of the loss of exclusivity are open to debate, the United States has chosen to take advantage of this feature of the current system. Realizing, as Dinerman summarizes, "the commercial remote sensing industry can fill some of the roles that used to be strictly the domain of the NRO," the president's 2009 proposal called not only for acquiring two evolutionary government-owned spacecraft but also for supporting industry in buying two improved commercial remote sensing satellites.[99] This approach parallels that of previous presidents who "ordered the intelligence community to buy commercial imagery whenever possible."[100] The on-orbit system today therefore must be thought of as more than a set of government-owned spacecraft. Instead, as Director of National Intelligence, Dennis Blair stated at the 2009 GEOINT conference, the United States is "basically committed to a foundational imagery architecture that's balanced, that incorporates both government systems and commercial systems."[101] Whether or not he is correct in his subsequent assessment—this approach "will serve this country well for many years into the future"—awaits further evaluation.[102]

Trait #6: Increasing Vulnerability

A final and nearly self-evident trait of the current system is its increasing vulnerability. While the nature of the satellites themselves has not changed dramatically, the nature of the threat continues to

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[97] Taylor Dinerman, "Spy Satellites Lose Their Mystique," *The Space Review* (23 Nov 2009), http://www.thespacereview.com/article/1516/1.
[98] Umberger, "Commercial Observation Satellite Capabilities," 9.
[99] Dinerman, "Spy Satellites Lose Their Mystique."
[100] Day, "Gum in the Keyhole."
[101] Dennis C. Blair, "2009 GEOINT Symposium Keynote" (Address, GEOINT 2009 Symposium, San Antonio, TX, 21 Oct 2009).
[102] Blair, "2009 GEOINT Symposium Keynote".

increase. The 2001 *Report of the Commission to Assess United States National Security Space Management and Organization* found today's space systems are "vulnerable to a range of attacks that could disrupt or destroy the ground stations, launch systems or satellites on orbit."[103] China's 2007 anti-satellite missile test provides just one example. As Adam Levine reports, "When China decided to test an anti-satellite missile in 2007, the impact shattered not just the target satellite but any illusions that China did not have military intentions in space and the capabilities to achieve them."[104] Over time, other nations will likely follow suit, further shattering illusions of security and increasing system vulnerability.[105] The Commission correctly captured this increasing vulnerability with their famous assessment—"The U.S. is an attractive candidate for a Space Pearl Harbor."[106]

Conclusion

Optimizing a national ISR system depends upon understanding the components that make up that system. These components can be separated into two primary categories—organizational components and technical components. Organizationally, the system has evolved such that two separate and distinct organizations—black and white space—with once clear lanes in the road now struggle to distinguish between one another's roles. While the organizations have remained separated, shared platforms have been developed to perform across the entire mission set. A small number of large platforms on-orbit today, controlled

[103] Commission to Assess United States National Security Space Management and Organization, *Report of the Commission to Assess United States National Security Space Management and Organization*, xii.
[104] Adam Levine, "In Today's Space Race, Watch Out for China," *CNN* (18 November 2009), http://www.cnn.com/2009/TECH/space/11/18/china.space/.
[105] For an excellent overview of threats to US space systems see: National Air and Space Intelligence Center, *Challenges to US Space Superiority*, (Wright Patterson AFB, OH: National Air and Space Intelligence Center, March 2005), 16-25.
[106] Commission to Assess United States National Security Space Management and Organization, *Report of the Commission to Assess United States National Security Space Management and Organization*, xiii.

by committee, collect a broad set of ISR data in a manner that has not dramatically changed through multiple block buys of the satellite across multiple decades. Commercial capabilities augment these platforms and are approaching the technical abilities of the government-owned systems. All space systems are becoming increasingly vulnerable to attack. Combining an understanding of these system traits—separate organizations with shared platforms—against the system objectives outlined previously allows one to answer the fundamental question sought in this work: To what extent is the current national overhead ISR strategy optimized?

Chapter 4

Assessments

> *The number of extended U.S. military commitments and other U.S. interests around the globe that require continuing support is stressing the capacity of NRO reconnaissance systems…*
>
> *Report of the National Commission for the Review of the National Reconnaissance Office, 2000*

> *The traditional focus of the NRO on innovation has been diverted…*
>
> *Report to Congress of the Independent Assessment Panel on the Organization and Management of National Security Space, 2008*

Consistent across numerous commissions and panels is the consensus that both the national security space system and the role of the NRO within that system could use improvement. The 1996 Jeremiah panel states, "While the Panel unanimously agreed on the importance of continuing the NRO, it nonetheless identified other major issues and provided recommendations for *improvement (*emphasis added)."[1] Similarly, the 2008 Young panel concludes, "The panel members are unanimous in our conviction that *significant improvements* in National Security Space (NSS) leadership, management, and organization are imperative to maintain U.S. space preeminence and avert the loss of the U.S. competitive national security advantage (emphasis added)."[2] In addition, the 2001 Rumsfeld Commission indirectly suggests improvement to the overhead intelligence strategy is needed, "To meet

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[1] Jeremiah Panel, *Defining the Future of the NRO for the 21st Century*, (Washington, DC, 26 August 1996), 4.

[2] A. Thomas Young et al., *Leadership, Management and Organization for National Security Space*, (Alexandria, VA: Institute for Defense Analyses, 2008), ES-1.

the challenges posed to space-based intelligence collection, the U.S. needs to review its approach to intelligence collection from space."[3]

While broad consensus exists that improvements are needed, the question remains, "Where do the shortfalls lie?" While each panel provides a set of recommendations, the purpose of this chapter is to independently assess this question in the context of the system objectives and components outlined in the previous chapters. By comparing system traits with system objectives, strengths and weaknesses of the current system in meeting the critical variables of execution agents and decision makers should readily emerge.

Correlating Objectives and Traits

Recall the framework of this study as identified in Chapter 1: Assessment of a system's optimality is possible through separate analysis of the system, the constraints on the system, and the predefined performance criterion. To this point in the analysis both the system itself, and the predefined performance criterion have been thoroughly outlined. While assessment of the system's true optimality requires a greater understanding of system constraints, introduction of a third set of considerations—i.e. constraints—greatly compounds the analysis. An initial assessment of system optimality in the context of just two dimensions—system components and performance criterion—should prove less problematic while also providing useful initial insights.

By making this assumption, objectively assessing the current national overhead ISR strategy becomes a straightforward process. Through simple cross-correlation of the critical variables identified for decision makers and execution agents with the key system traits, sub-optimalities in the current system readily emerge.

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[3] Commission to Assess United States National Security Space Management and Organization, *Report of the Commission to Assess United States National Security Space Management and Organization*, (Washington, DC: Department of Defense, 11 January 2001), 34.

Table 4 represents one method for executing this cross-correlation. Critical system objectives span the four columns. Each of the seven system traits are captured by the seven rows. The intersection of each row and column provides an opportunity to assess a given system trait's positive or negative contribution towards achieving each objective. It should be noted, however, that these trait/objective assessments are not intended as definitive conclusions regarding the current national overhead ISR system. Rather, Table 4 summarizes the theoretical contributions each trait, by virtue of its inherent nature, could be expected to exert on the desired objectives. A brief rationale for the assessed theoretical contributions of each trait follows the table.

Table 4: Cross-Correlation Matrix of System Objectives and Traits

Key: ↔ = No significant impact on objective ↓ = Negative impact on objective ↑ = Positive impact on objective	**Exquisiteness / Inconceivability**	**Frequency**	**Timeliness**	**Guaranteed, Continued Support**
Few in Number	↔	↓	↔	↓
Control by Committee	↔	↓	↓	↓
Broad in Scope	↓	↔	↔	↓
Short in Revolutionary Advancement	↓	↔	↔	↔
Waning Government Exclusivity	↓	↑	↔	↔
Increasing Vulnerability	↔	↔	↔	↓
Distinct Organizations/Overlapping Missions	↓	↓	↓	↓

Source: Author's Original Work

- *Few in number:* Exquisiteness and timeliness are functions of the type of spacecraft on orbit rather than the number. Conversely, the laws of orbital dynamics dictate the frequency with which a given object of interest enters the field of view of a system. Recalling the execution agent's frequency objective in support of surveillance approaches the need for persistence, a system with fewer spacecraft is obviously sub-optimized in this regard. Additionally, a smaller number of spacecraft negatively impacts the execution agent's objective for guaranteed, continued support in two regards. First, the smaller the number of spacecraft, the greater the level of competition in the system—a concept that runs contrary to the need for guaranteed support. Second, fewer spacecraft makes assurance of continued support more difficult in the face of internal failures or external threats.
- *Control by Committee:* As a small number of on-orbit assets drive increased levels of competition, that competition must be mediated in some manner. Merging collection requirements for execution agents and decision makers into one consolidated pool, controlled by committee, suggests one community's identified requirements will be prioritized over the other. Such a prioritization approach must include the possibility that execution agent's requirements may be out-prioritized and increases the potential that the objectives of frequency and guaranteed support will become sub-optimized. The adjudication layer introduced by a control by committee approach also has the potential to impact system timeliness negatively. The exquisiteness objective remains relatively unimpeded by the mechanism selected for day-to-day operational control.
- *Broad in Scope:* By attempting to balance strategic and tactical requirements, not just in day-to-day operations but also in the design of on-orbit platforms, additional levels of competition are introduced

into the system. The introduction of competition during the design phase negatively impacts the exquisiteness objective as innovative technologies may be traded off for more familiar ones in support of execution agents' needs for guaranteed support. Alternatively, trades of familiar technologies for innovative ones may negatively impact execution agents' objectives. Thus, while frequency and timeliness objectives remain unaffected, the mega-sensor platforms that result from a system that is broad in scope optimally serve neither decision makers nor execution agents.

- *Short in Revolutionary Advancement:* A system of evolutionary advancement is noticeably sub-optimal with respect to exquisiteness and inconceivability. While a revolutionary system redesign could drive indirect changes to frequency, timeliness, or guaranteed support, the lack of revolutionary advancement is not seen as a primary driver of sub-optimalities in these areas.
- *Waning government exclusivity:* This trait's impact on the system objectives is mixed. On one hand, the introduction of commercial satellites into the system is a clear detriment to the exquisiteness and inconceivability objective imposed on the system by decision makers. This trait does have the potential, however, due to the creation of more opportunities per day for objects of interest to be seen, to positively impact the system as it meets the objective of frequency. Timeliness and guaranteed continued support are not seen as directly impacted by the waning government exclusivity.
- *Increasing Vulnerability*: A system whose vulnerability is increasing is clearly sub-optimal with respect to an objective for guaranteed, continued support. Other objectives, however, remain relatively unaffected by this trait.
- *Distinct organizations with overlapping missions:* A system with organizations distinct in chains and span of control, but blurred

regarding missions and purposes introduces significant potential for uncontrollable competition. Absent a strong centralized control mechanism (the introduction of which would change the nature of the system), such competition will weaken all objectives, across the board. Neither the execution agents' objectives nor the decision makers' objectives will receive focused attention as the distinct organizations pursue parallel but potentially incongruent solutions.

Cross-correlation Trends

Admittedly, the methodology used to assess system optimality as captured by Table 4 has shortcomings. As Robert Jervis emphasizes, reductionism—"seeking to understand the system by looking only at the units and their relations with one another"—can often lead to error in assessment.[4] Given that the "whole is different from the sum of the parts," analysis which decomposes a complex system into separate and distinct parts risks failing to capture the true complexities of the system.[5]

Given the risk inherent in reductionism, assessing themes or trends from cross-correlation becomes more useful than pursuing a detailed assessment of the optimality impacts driven by each trait/objective intersection. While one trait's negative impact on a given objective may not indicate overall system sub-optimality, continual emergence of such impacts across multiple traits or objectives does indicate areas where optimality is lacking. As this analysis transitions from a theoretical trait/objective correlation to a more practical assessment, viewing Table 4 from this broader perspective overcomes the shortcomings of reductionism and yields more accurate insights.

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[4] Robert Jervis, *System Effects: Complexity in Political and Social Life* (Princeton, NJ: Princeton University Press, 1997), 13.
[5] Jervis, *System Effects: Complexity in Political and Social Life*, 12.

Trend #1: The current system fails to meet the decision maker's objective of exquisiteness and inconceivability.

Consistent across multiple system traits is the negative impact of the current system on the existence of capabilities of which "adversaries can't even conceive"—the critical objective for decision makers.[6] The combination of factors driving mega-mission platforms to be developed in an evolutionary manner to support the blurred missions of both black and white space has had a direct and negative impact on system innovation. Absent innovation, exquisiteness and inconceivability are unlikely to evolve.

Multiple external assessments over multiple years support this conclusion. The 1996 Jeremiah Panel sought to answer the question, "Is the NRO still an innovative organization?" and found, "The NRO needs a new approach if it is to successfully develop innovative new solutions with revolutionary capabilities."[7] The 2000 Commission for Review of the NRO determined, "The key to future space-based access and to future capability in the face of actions by those who would conceal their own capability, intent and will is technology," but simultaneously determined, the "increasing bureaucracy and other changes in the NRO's organizational and operating structure" had "begun to take their toll" on innovation.[8]

Even the more broadly focused 2001 Commission to Assess United States National Security Space Management and Organization made the system's lack of innovation a point of emphasis. They note: "In its early years, the NRO was a small, agile organization, a leader in developing advanced technologies, often first-of-a-kind systems, for solving some of the nation's most difficult intelligence collection challenges. The NRO

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[6] Major General (retired) James B. Armor, Jr., interview by the author, 22 February 2010, Beltsville, MD. Audio recording in author's personal archives.

[7] Jeremiah Panel, *Defining the Future of the NRO for the 21st Century*, 12.

[8] National Commission for the Review of the National Reconnaissance Office, *The NRO at the Crossroads*, (Washington, DC, 2000), 32-34.

today is a different organization, simultaneously struggling to manage a large number of legacy programs while working to renew a focus on leading edge research."[9] They go on to state, "The U.S. must invest in space-based collection technologies that will provide revolutionary methods for collecting intelligence, especially on difficult intelligence targets."[10] In short, the current system fails to provide the exquisite, innovative technologies and capabilities the nation needs to successfully conduct "complex diplomatic initiatives," provide "strategic warning of significant political and military events," "support research into countermeasures to the weapons of potential adversaries," and "maintain its other activities not directly related to military operations."[11] Fundamentally, the current system fails to optimally meet the objective of decision makers.

Lest one conclude the NRO of 2001 to be substantially different than the NRO of today, evidence suggests otherwise. In 2008, the congressionally directed Independent Assessment Panel on the Organization and Management of National Security Space found "the traditional focus of the NRO on innovation has been diverted."[12] Additionally, Dr. Pete Rustan, Director, Mission Support Directorate at the NRO reinforced the diversion away from innovation in a 2010 interview with his assessment that the NRO of today is primarily "focused on acquisition management."[13]

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[9] Commission to Assess United States National Security Space Management and Organization, *Report of the Commission to Assess United States National Security Space Management and Organization*, xxiii.

[10] Commission to Assess United States National Security Space Management and Organization, *Report of the Commission to Assess United States National Security Space Management and Organization*, 34.

[11] Commission to Assess United States National Security Space Management and Organization, *Report of the Commission to Assess United States National Security Space Management and Organization*, 34.

[12] Young et al., *Leadership, Management and Organization for National Security Space*, 15.

[13] Dr. Pete Rustan, interview by the author, 25 February 2010, Chantilly, VA. Notes in author's personal archives.

One caveat should be noted at this point in the analysis. As highlighted in Chapter 1, all research for this effort was performed at the unclassified level. It is safe to assume that should exquisite sensors of the type required to meet the decision maker's objective exist, their very existence would not be acknowledged outside highly classified channels. It is therefore possible that such sensors exist but were not studied. While acknowledging this possibility, the evidence at hand, to include the assessments of both past commissions and current NRO leaders indicates a negative trend relative to this trait.

Trend #2: The current system lacks the ability to meet execution agent's objective of guaranteed, continued support

In Chapter 2, a primary objective for execution agents—guaranteed, continued support—was defined as having two principal components: "assuredness of tasking" and "assuredness of capability."[14] A review of trends across all system traits reveals a failure to meet this objective in both regards. Competition introduced through the broadness of on-orbit spacecraft coupled with control by committee drives lower levels of assuredness as it relates to tasking. Similarly, the combination of a low number of active satellites and increasing vulnerability of the system to adversary action drive increased risk that capability cannot be assured. In short, the current system is sub-optimal as it relates to execution agents' objective for guaranteed, continued support.

While this conclusion is not explicitly or abundantly stated in recent panel reports, Congressional action indicates assuredness is an area of concern. A prime example of this concern can be found in recent events surrounding the concept of Operationally Responsive Space (ORS). In 2007, via the National Defense Authorization Act, Congress

[14] C. Robert Kehler, "2008 Global Warfare Symposium Keynote" (Address, Global Warfare Symposium, Beverly Hills, CA, 21 Nov 2008).

directed the secretary of defense to create the Operationally Responsive Space Program Office.[15] The congressionally directed goals for the office—"fulfill joint military operational requirements" and fulfill a need for "on-demand space support and reconstitution"—parallel closely the objectives of assuredness in tasking and assuredness in capability as presented in Chapter 2.[16] The Department of Defense's subsequent report to Congress further emphasized this link as it defined ORS as, "*Assured space power* focused on timely satisfaction of *Joint Force Commanders' needs* (emphasis added)".[17] Importantly, ISR has emerged amongst the "mission areas of interest" as the program has sought to fulfill the prioritized emphasis on joint force commanders' needs.[18] The existence of a congressional mandate driving a Department of Defense focus on "assured space power" for warfighter's needs (to include ISR) indicates the recognition of a lack in the existing system's ability to meet executive agents' objective of assuredness.[19]

The growing recognition of the vulnerability inherent in space-based ISR platforms also supports the conclusion that the existing system lacks an ability to meet execution agents' objective of guaranteed, continued access. One year after directing the initiation of an ORS program, Congress took action to recognize the protection aspect of the assuredness problem. The Fiscal Year 2008 National Defense Authorization Act highlighted "the Sense of Congress that the United States should place greater priority on the protection of national security space systems," and directed the secretary of defense and the director of

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[15] *John Warner National Defense Authorization Act for Fiscal Year 2007*, Public Law 109-364, 109th Cong., 2nd sess., 17 October 2006, 273.
[16] *John Warner National Defense Authorization Act for Fiscal Year 2007*, 273.
[17] Department of Defense, *Plan for Operationally Responsive Space: A Report to Congressional Defense Committees*, (Washington, DC: National Security Space Office (NSSO), 17 April 2007), 2-3.
[18] Robert P. McCoy and Larry Schuette, "New Way of Doing Business in Space," *Military Space & Missile Forum* 2, no. 6 (2009).
[19] Department of Defense, *Plan for Operationally Responsive Space: A Report to Congressional Defense Committees*, 2-3.

national intelligence to "develop a strategy, to be known as the Space Protection Strategy, for the development and fielding by the United States of the capabilities that are necessary to ensure freedom of action in space."[20] In addition to developing a Space Protection Strategy, defense and intelligence officials further underscored their recognition of this system deficiency by creating a new Space Protection Program with the stated purpose of providing "decision-makers with strategic recommendations on how best to protect our space systems"—i.e. increase assuredness.[21]

An entirely separate analysis could be pursued assessing the positive and negative aspects of the Operational Responsive Space and Space Protection Programs. While both ORS and Space Protection have the potential to change the nature of the nation's overhead ISR strategy, neither has had a significant impact to date. As a result, deriving conclusions or arguments for or against these solutions is deemed outside the scope of this analysis. Instead, this work simply argues that the very creation of these offices via congressional direction and defense and intelligence community initiatives highlight a general recognition of the second trend evident in Table 4—current system traits do not support execution agents' objective of guaranteed, continued access.

Trend #3: While room for improvement exists, the current system supports execution agents' timeliness and frequency objectives

In a February 2010 interview, while agreeing with "the basic premise" of this study to include the high-level concepts presented in support of the first two trends, General Thomas Moorman emphasized that despite challenges, there are also areas where the system is

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[20] *National Defense Authorization Act for Fiscal Year 2008*, Public Law 110-181, 110th Cong., 2nd sess., 28 January 2008, 277.
[21] Ben Iannotta, "Space Protection: How Far will America Go to Protect its Satellites?," *C4ISR Journal* 7, no. 5 (2008).

succeeding.[22] The first and foremost "good news" story he identified as "operations."[23] Interpreted as an assessment of the positive contributions from space-based ISR to the current conflicts in Afghanistan and Iraq, General Moorman's conclusion supports a final trend that is evident across Table 4: While not perfectly tuned to support the objectives of timeliness or frequency, on a relative basis (i.e. as compared to the other two objectives), the current system is performing admirably well. Until persistent coverage with instantaneous information transfer to the warfighter becomes a reality, room for improvement will obviously remain, but the relative lack of significant negative trends across these objectives indicates the current system is nearly "good enough"—this study's requirement for optimality.[24]

Those closest to the current fight support this conclusion. In visiting half the Combatant Commands (COCOMs), NRO Director Bruce Carlson found, "To the man they are incredibly complimentary of what the (NRO) is doing."[25] While agreeing that room for improvement exists, current Central Command (CENTCOM) Director of Space Forces (DIRSPACEFOR), Colonel David Thompson is also complimentary—assessing that overall, "support to real-time and near real-time combat ops is pretty good."[26] Former DIRSPACEFOR, Colonel Jeffrey Yuen also concurs: "From an allocation standpoint we have optimized this system."[27] In general, the impression received is that the "closer you get to the mission" the more irrelevant the tensions and sub-optimalities in

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[22] General (retired) Thomas S. Moorman, Jr., interview by the author, 22 February 2010, Herndon, VA. Notes in author's personal archives.
[23] Moorman, interview.
[24] Frederick S. Hillier and Gerald J. Lieberman, *Introduction to Operations Research*, 6th ed., McGraw-Hill Series in Industrial Engineering and Management Science (New York: McGraw-Hill, 1995), 15.
[25] Bruce Carlson, "2009 GEOINT Symposium Keynote" (Address, GEOINT 2009 Symposium, San Antonio, TX, 21 Oct 2009).
[26] Colonel David Thompson, interview by the author, 4 February 2010 via video teleconference (VTC). Notes in author's personal archives.
[27] Colonel Jeffrey Yuen, interview by the author, 25 February 2010, Chantilly, VA. Notes in author's personal archives.

the system become—not because these inefficiencies disappear, but rather because an overarching focus on near-term life or death missions drives those involved to find ways around the sub-optimalities.[28]

Despite this relative success, the military is, as one might expect, pursuing solutions to improve operational relevance as captured by the objectives of frequency and timeliness. As relates to frequency, one intent of ORS is to "provide the theater commander with persistent coverage."[29] Recognizing 24 x 7 coverage as "not economically feasible," ORS defines persistence is as eliminating "any militarily exploitable holes where an adversary could conduct significant operations between over flights"—a significant improvement to system frequency, if achieved.[30] Additionally, one of ORS's early initiatives, Tactical Satellite-3 (TacSat-3), seeks to enhance system timeliness greatly. The mission of TacSat-3's primary payload, the Advanced Responsive Tactically-Effective Military Imaging Spectrometer (ARTEMIS), is to deliver data to the warfighter on the ground "within minutes"—also a significant improvement, if achieved.[31]

Conclusion

While seeking improvements in the areas of frequency and timeliness will improve overall system optimality, this assessment concludes that the traits of timeliness and frequency are not the most pressing sub-optimalities facing the current national space-based overhead ISR strategy. By correlating previously identified traits with system objectives via reductionist and more holistic approaches, this assessment has identified lack of innovation and assuredness as negative trends upon which national optimization efforts should focus.

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[28] Thompson, interview.
[29] Don Knight, "Concept of Operations for Operationally Responsive Space," in *4th Responsive Space Conference* (Los Angeles, CA: AIAA, 2006), 6.
[30] Knight, "Concept of Operations for Operationally Responsive Space," 6.
[31] Peggy Hodge, "TacSat-3, Other ORS Initiatives Benefit Warfighter," *SMC News* (18 June 2009), http://www.losangeles.af.mil/news/story.asp?id=123154953.

Chapter 5

Reframing and Recommendations

> *We are trying to satisfy everybody's requirements on one system, and those requirements now, because of the way we use space for warfighting purposes, have become competitive in some places…The demands for national intelligence collection and the demand for real time military operations, again in my view, cannot be reconciled with one platform.*
>
> *General Robert C. Kehler*
> *Commander, Air Force Space Command*

> *The needed focus on innovation can be restored by rebalancing sustainment, operations, and routine production tasks within a unified organization.*
>
> *Report to Congress of the Independent Assessment Panel on the Organization and Management of National Security Space, 2008*

> *The formulation of a wicked problem is the problem! The process of formulating the problem and of conceiving a solution are identical, since every specification of the problem is a specification of the direction in which a treatment is considered.*
>
> *Horst W. J. Rittel and Melvin M. Webber*

As highlighted in the introduction to this work, the issues uncovered through the preceding analysis are not new or particularly original. Rather, both the overhead ISR system's lack of assuredness and the declining levels of exquisiteness in the system are simply restatements of assessments that have surfaced through commissions and studies dating back more than a decade. Associated with these common assessments, a relatively standard set of recommendations has also repeatedly appeared. Focused at times on technological traits, but more often on organizational solutions, this recurring set of recommendations has sought to overcome the sub-optimalities in the

system and ultimately to "restore space…excellence and maintain the United States' position as the world's leader in space."[1]

Despite frequent repetition of both issues and recommendations, however, recent assessments continue to indicate a lack of optimality in the system. The 2008 *Report to Congress of the Independent Assessment Panel on the Organization and Management of National Security Space* found the current "inadequacies" are "unacceptable today and are likely to grow."[2] Similarly, General Kehler's assessment, as woven throughout this analysis, clearly proposes the current approach is "posing problems" and suggests "those problems are going to get worse as we look to the future."[3]

From one perspective, the persistence of system sub-optimalities in the face of their repeated identification simply results from a lack of emphasis by those who have the perceived ability to modify the system. A consensus seems to be forming that despite frequent repetition, the challenges are being ignored and the recommendations disregarded. As evidence of this growing consensus, the House Sub-Committee on Technical and Tactical Intelligence claimed in their 2008 report that, "the Committee has raised many of these issues before," but that the recommendations appear to have been "ignored."[4] They go on to suggest, "The nation cannot afford to continue to ignore the issues."[5]

By focusing upon the system constraints which have limited the implementation of previous recommendations, this chapter proposes an alternative view. Perhaps the recommendations have not been ignored,

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[1] House, *Report on Challenges and Recommendations for United States Overhead Architecture*, 110th Cong., 2nd sess., 2008, H. Rept. 110-914, 2.
[2] A. Thomas Young et al., *Leadership, Management and Organization for National Security Space*, (Alexandria, VA: Institute for Defense Analyses, 2008), 11.
[3] C. Robert Kehler, "One Size Does Not Fit All" (Address, GEOINT 2008 Symposium, Nashville, TN, 30 Oct 2008).
[4] House, *Report on Challenges and Recommendations for United States Overhead Architecture*, 6.
[5] House, *Report on Challenges and Recommendations for United States Overhead Architecture*, 6.

but are, in the context of the constrained system, simply unobtainable. By focusing upon previous recommendations in the context of system constraints, this chapter seeks to answer a final, and likely most important question—how should the nation proceed to resolve the identified issues and ultimately achieve greater optimality in its national overhead ISR strategy?

In Search of the Right Problem

The concept of a "wicked problem," as introduced by Rittel and Webber in their classic work, *Dilemmas in a General Theory of Planning*, becomes useful as one seeks to identify how the nation should proceed.[6] As defined by Rittel and Webber, "wicked" problems, which include "nearly all public policy issues," are distinguished from "tame" ones in their lack of distinct definability and their reliance on "elusive political judgment" for resolution.[7] Given these problems' lack of distinct definability, the process of formulating the problem becomes more important than solving it—"every specification of the problem is a specification of the direction in which a treatment is considered."[8] In short, how one defines the problem dictates the nature of the solution one pursues.

While it is debatable whether the entire range of Rittel and Webber's concepts and theories apply to the optimization of the national overhead ISR strategy, the relevance of their emphasis on problem formulation is not. Until the problem is adequately defined—or more correctly stated, properly re-defined—system optimality will remain elusive. Called "reframing" by Stefan Banach and Alex Ryan, the intent of problem re-definition is to identify "new opportunities" and "overcome obstacles to progress" when "interactions with the real world situation or

[6] Horst W. J. Rittel and Melvin W. Webber, "Dilemmas in a General Theory of Planning," *Policy Sciences* 4(1973): 160.
[7] Rittel and Webber, "Dilemmas in a General Theory of Planning," 160.
[8] Rittel and Webber, "Dilemmas in a General Theory of Planning," 161.

new sources of information reveal issues with a current problem."[9] The lengthy debate and ongoing attempts to improve the national space-based ISR strategy indicate the nation faces exactly this situation: Interactions and new sources of information have revealed "obstacles to progress."[10] Rather than search for differing solutions to the currently identified problem, the nation must first seek to identify "whether the right problem is being solved."[11]

The Technological Frame

The right problem initially appears technological in nature. A number of the technical system traits, as described in Chapter 3, are negatively impacting system optimality, as assessed in Chapter 4. Being few in number negatively impacts system optimality relative to the objectives of frequency and assuredness; the on-orbit systems' broadness negatively affects innovation; and so forth. When viewed from this frame, both the system's failure to provide exquisiteness to decision makers and the system's inability to guarantee, continuing support to execution agents can be attributed to straightforward technical shortcomings.

General Kehler's platform-centric assessment captures this perspective: "We have tried to satisfy the needs of both the intelligence community and the warfighters on single platforms. I think that approach is posing insurmountable problems for us today."[12] Note the directness with which Kehler ties the technological approach of single platforms to the problem of failing to satisfy diverse needs. Kehler also assesses other panels as having adopted this same perspective, "Every single review panel that we have had…has come back with as part of their critique that we are trying to accommodate too many things per

[9] Stefan J. Banach and Alex Ryan, "The Art of Design: A Design Methodology," *Military Review* (March-April 2009): 107.
[10] Banach and Ryan, "The Art of Design: A Design Methodology," 107.
11 Banach and Ryan, "The Art of Design: A Design Methodology," 107.
[12] C. Robert Kehler, "2008 Global Warfare Symposium Keynote" (Address, Global Warfare Symposium, Beverly Hills, CA, 21 Nov 2008).

platform."[13] Describing the problem by focusing on the system trait of platform broadness is representative of framing the problem along technological lines.

Viewing the problem from the perspective of acquisition requirements is a slightly more subtle approach to framing the problem along technological lines, but yields the same result—system weaknesses tied directly to technical shortcomings. Kehler captures this notion in his assessment of previous review panels. Commenting on previous panel conclusions, Kehler finds that all previous panels identified a "press on requirements and complexity" as a "factor in what went wrong with many of our space programs."[14] He then assesses that the needed focus lies "in the requirements piece of what we're doing."[15] While arguably slightly different ways of viewing the problem, a focus on system traits and a focus on the acquisition requirements that drive those traits are essentially two sides of the same problem frame—the technical components of the overhead ISR system are not optimized to meet the broader system objectives.

A Technological Frame Solution—System Segregation

When viewed from the technological frame, the optimization solution appears self-evident—find technical system traits that are negatively impacting system optimality and introduce new sets of acquisition requirements that will lead to their change. Using this approach, the negative impacts of the increasing vulnerability trait can be nullified through the introduction of new space protection requirements. The detrimental impacts of having too few satellites on orbit can be solved simply by building more. The impacts of evolutionary versus revolutionary system upgrades can be lessened by requiring a break from traditional technical approaches. Independent of the specific

[13] Kehler, "2008 Global Warfare Symposium Keynote".
[14] Kehler, "2008 Global Warfare Symposium Keynote".
[15] Kehler, "2008 Global Warfare Symposium Keynote".

trait targeted, the approach remains the same—offset negative impacts by attempting to change particular technical traits.

Building upon the same line of thinking, a more efficient approach inside the technological frame would be the modification of one technical trait that indirectly drives changes amongst others. If alteration of one trait indirectly transforms other traits in a manner that drives a weakening of their impacts, overall system optimality will be more readily achieved. Obviously, modification of some traits will not achieve such expansive effects. For example, requiring more satellites to be built may indeed lessen the negative impacts caused by few on-orbit assets, but if the resultant system is simply a greater number of large, legacy spacecraft, the overall system impacts of such a solution will be minimal. As a result, this analysis suggests those who seek solutions inside the technological frame should make identification of traits with expansive indirect effects a primary focus.

Reviewing the solutions proposed inside the technological frame, one finds the trait of broadness garnering much attention. General Kehler's conclusion indicating that the time is right for a "shift to a new architecture that accommodates the needs of both with platforms purposely designed for specific warfighter or national intelligence needs" is a prime example.[16] Former senior adviser to the undersecretary of defense for acquisition, technology and logistics, Joshua Hartman's proposal for a "balanced architecture" where a "foundational capability would come from medium or large systems" complemented by "small, agile, less complex systems" also exemplifies the attention the trait of broadness is receiving.[17]

Does targeting the trait of broadness achieve the expansive effects desired, however? As a first order effect, requiring separate platforms to

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[16] Kehler, "One Size Does Not Fit All".

[17] Joshua Hartman, "Adapting to Succeed in Space Intel," *Defense News* (5 October 2009), http://www.defensenews.com/story.php?i=4307554.

meet the objectives of decision makers and execution agents would allow each set of users to tailor the platforms to their needs—thereby minimizing the impacts to exquisiteness and assuredness that the trait of broadness has caused. Perhaps more importantly, segregation of platforms has the potential to indirectly drive positive changes to the current system traits of small on-orbit numbers, control by committee, lack of revolutionary advancement, and increasing vulnerability.

As one example of this indirectness, Secretary Gates suggests broadness has indirectly limited the number of spacecraft the nation has been able to buy. He claims systems became "technically infeasible and unaffordable" as a result of capabilities being "piled on,"—ultimately limiting the number of spacecraft in the current system.[18] Targeting the trait of broadness, therefore, would reverse the "piling on" trend and indirectly allow the nation to "get past an era where the platforms become so expensive that (it) can only buy a small number of them."[19] In short, requiring a change to one attribute—broadness in scope—would result in positive changes in another.

A similar case can be made for the relationship between broadness and nearly all key technical traits identified in this study. Decreased broadness will indirectly drive revolutionary advancements as it removes the need to pursue balanced designs to "meet the requirements of both the national intelligence community and the joint force commanders."[20] The negative impacts of control by committee and increasing vulnerability will decline as the number of more focused platforms proliferates. In short, requiring a change to one attribute—broadness in scope—results in expansive system modifications and is a viable solution for pursuing system optimization inside the technological frame.

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[18] Quoted in Hartman, "Adapting to Succeed in Space Intel."
[19] Quoted in Hartman, "Adapting to Succeed in Space Intel."
[20] Kehler, "One Size Does Not Fit All".

The Organizational Frame

Although not incorrect in their assessment of the problem, those who view the problem and associated solutions through a technological perspective risk overlooking a separate, and perhaps more important piece of the optimization dilemma. While requirements shape the technical traits and eventual output of the system, these requirements are themselves a direct result of the organizational traits of the system. As captured by the National Commission for Review of the NRO, the challenge faced by the NRO is not so much responding "to rigid requirements for new reconnaissance systems" but rather that these requirements only surface after "extensive negotiations among a wide variety of strategic and tactical customers."[21] A sub-optimal organizational structure which prevents optimal requirements from surfacing and shaping the technological system forms a second framework for viewing this problem.

Support for this methodology for framing the problem is evident across the literature. The *Report to Congress of the Independent Assessment Panel on the Organization and Management of National Security Space* assessed that many "important new programs…have been hamstrung by the inability to resolve interagency differences in setting achievable requirements and resource priorities."[22] Burrows concludes "What has been learned is that engineering advances in technical intelligence collection…have been easier to come by than political advances if the latter are defined as a set of common goals and mutual

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[21] National Commission for the Review of the National Reconnaissance Office, *The NRO at the Crossroads*, (Washington, DC, 2000), 38.
[22] Young et al., *Leadership, Management and Organization for National Security Space*, 14.

support within the intelligence establishment."[23] And Lindgren bluntly assesses the problems as "more organizational than technological."[24]

Organizational Frame Solutions—Organizational Integration

The recommendations of the 2008 Independent Assessment Panel chaired by Thomas Young are representative of the solutions proposed by those who view the problem from an organizational frame. Chartered to "review and assess the Department of Defense management and organization of national security in space and make appropriate recommendations to strengthen the U.S. position," their final report places great emphasis on the relationship between the current organizational structure and the weaknesses outlined in this assessment: "As the military uses of NRO capabilities expand in volume and importance, the *organization* for National Security Space must evolve to ensure that both NRO and military space activities are sufficiently *integrated* to effectively acquire needed capabilities and to provide excellent operational support for military operations, while continuing to meet the needs of Intelligence Community customers (emphasis added)."[25] The panel's recommended solution is extensive: "Create a National Security Space Organization (NSSO). Assign to it the functions of the National Reconnaissance Office, the Air Force Space and Missile Systems Center, the Air Force Research Laboratories Space Vehicles Directorate, the operational functions of the of Air Force Space Command (AFSPC), and Army and Navy organizations now providing space capability."[26] Put bluntly—eliminate the sub-optimalities in the current

[23] William E. Burrows, "Satellite Reconnaissance," in *The Intelligence Revolution and Modern Warfare*, ed. James E. Dillard and Walter T. Hitchcock (Chicago: Imprint Publications, 1996), 197.
[24] David T. Lindgren, *Trust but Verify: Imagery Analysis in the Cold War* (Annapolis, MD: Naval Institute Press, 2000), 193.
[25] Young et al., *Leadership, Management and Organization for National Security Space*, 7, 24.
[26] Young et al., *Leadership, Management and Organization for National Security Space*, 15-16.

system by fully integrating space organizations under common leadership.

Others propose less drastic measures but still attack the problem from the organizational frame. One such approach favored by General Moorman is renewal of the Executive Committee or EXCOM.[27] President Johnson created this committee in 1965 in an effort to oversee the NRO's budget, structure, and research and development.[28] Comprised of the deputy secretary of defense, the director of central intelligence (DCI) and the president's scientific advisor, the EXCOM was an organizational solution designed to, as captured by Lindgren, achieve "balance between the interests of the Air Force and CIA."[29] With Executive Order 11905, President Ford restructured the intelligence community, made the NRO a formal part of the intelligence community, and disbanded the EXCOM.[30]

Those who view the problem through the organizational frame argue that the disbandment of the EXCOM significantly degraded the relationship between the Department of Defense and the intelligence community as it relates to the NRO—specifically the management relationship between the secretary of defense and the director of central intelligence. The 2000 Commission for Review of the NRO found "the uncertain situation in which the NRO finds itself today…can be traced to the ambiguity and recent inadequacy of the secretary of defense-DCI relationship as a means of resolving disputes relating to the NRO."[31] Similarly, General Moorman suggests the amount of staffing required before any issue related to the overhead ISR strategy reaches the director of national intelligence (DNI) or secretary of defense in the current

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[27] General (retired) Thomas S. Moorman, Jr., interview by the author, 22 February 2010, Herndon, VA. Notes in author's personal archives.
[28] Curtis Peebles, *Guardians: Strategic Reconnaissance Satellites* (Novato, CA: Presidio Press, 1987), 87.
[29] Lindgren, *Trust but Verify: Imagery Analysis in the Cold War*, 114.
[30] National Commission for the Review of the National Reconnaissance Office, *The NRO at the Crossroads*, 107-108.
[31] National Commission for the Review of the National Reconnaissance Office, *The NRO at the Crossroads*, 46.

organizational construct severely "insulates" these individuals from the issues and negatively impacts their ability to manage this "special relationship."[32] Moreover, General Moorman states, the disbandment of the EXCOM has also negatively impacted innovation: "A decision to introduce new capabilities will invariably involve technical, programmatic and budgetary trades-–decisions which ultimately can only be made by the secretary of defense and DNI working together."[33]

The logical solution proposed by those who view the problem through this frame is organizational change that strengthens this "special" relationship.[34] The NRO Commission identified the "need for a close and sustained working relationship between the secretary of defense and the director of central intelligence" and suggested "the NRO should be the subject of at least a weekly discussion between the secretary of defense and the DCI" (now DNI).[35] General Moorman suggests one way to create this relationship is by re-establishing the EXCOM, thereby forcing periodic discussion.[36] This suggestion has been taken seriously, and a new draft NRO charter contains a provision for the formation of an EXCOM where, as current NRO Director Bruce Carlson claims, the relevant senior leaders can "make important decisions about national overhead."[37]

Whether centered upon the creation of a new, fully integrated space organization, the re-creation of an EXCOM, or some other iteration of organizational restructuring, these solutions all derive from the same fundamental premise—eliminate system sub-optimalities by bringing organizations closer together. By focusing upon the system trait of

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[32] Moorman, interview.
[33] Moorman, interview.
[34] Moorman, interview.
[35] National Commission for the Review of the National Reconnaissance Office, *The NRO at the Crossroads*, iv, 113.
[36] Moorman, interview.
[37] Bruce Carlson, "2009 GEOINT Symposium Keynote" (Address, GEOINT 2009 Symposium, San Antonio, TX, 21 Oct 2009).

distinct organizations with merged missions, proponents frame the problem as organizationally based and, in so doing, suggest solutions along similar lines. Whether solving the problem in the organizational frame is the right problem remains to be seen, however.

The Competition Frame

Both the technological and organizational frames allude to, but fail to capture directly the central issue—competition is inherent in any ISR system attempting to meet the objectives of both execution agents and decision makers. As highlighted in Chapter 2, the critical variables for execution agents and decision makers fundamentally differ. This fact is significant and cannot be changed by either properly identifying technological requirements or creating better organizational structures. As General Kehler states, "because of the way we use space for warfighting purposes, (requirements) have become competitive in some places."[38] ISR is one of those places. It should therefore come as no surprise that, as the House Subcommittee on Tactical and Technical Intelligence found, "the Intelligence Community and DoD seem at odds with each other over satellite program requirements."[39] There is indeed a "competition between DoD and the Intelligence Community for mission-specific requirements"—this is the fundamental problem.[40]

Having identified competition as the central challenge, the right problem should logically follow. Attempts to capture the problem in a competition-centered frame must proceed cautiously, however. Assuming the problem to be eliminating competition will drive non-optimal solutions. The divergent nature of the strategic and tactical ISR objectives ensures competition cannot be eliminated from the system.

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[38] Kehler, "2008 Global Warfare Symposium Keynote".
[39] House, *Report on Challenges and Recommendations for United States Overhead Architecture*, 11.
[40] House, *Report on Challenges and Recommendations for United States Overhead Architecture*, 11.

The right problem then is not the elimination of competition but rather minimizing its negative impacts. By creating mechanisms which minimize the impacts of competition in the system, optimal results may be achieved.

Recommendation #1: Recognize the problem for what it is—differing tactical and strategic intelligence objectives driving continual competition. Pursue solutions which seek to minimize the negative impacts of this inherent competition.

Competition Frame Solutions—A Segregation/Integration Mix

Having reframed the problem to focus on its fundamental nature—minimizing the impacts of inherent competition, as opposed to components of the problem, organizational and technological traits—one can now pursue a framework for problem resolution. The key insight is this: While competition is a function of both organizational and technological traits, the problem is minimizing competition's impacts by manipulating these traits, not maximizing or minimizing these traits in and of themselves. This reframing drastically shapes competition frame solution methodologies.

Development of competition frame solutions hinges upon understanding previous solutions in the context of this frame. Of note, solutions suggested by framing the problem in both the technological and organizational frames indirectly attempt to solve the right problem—minimizing competition's negative impacts. Building independent platforms specifically to support each user set, while a technological frame solution, would, indeed, reduce the impacts of competition in the system. While not eliminating the strategic and tactical objective competition inherent in the system, a segregated technological system structure would better facilitate fulfilling both sets of objectives. Similarly, organizational reform centered upon integration, while not

eliminating competition, would create a mechanism—a centralized leadership structure—whereby negative impacts could be more thoroughly assessed and mitigated. Thus, while neither the technological nor the organizational frame directly attack the right problem, the solutions identified in those frames prove valuable in identifying competition frame solutions.

Table 5 proposes an organizational frame solution matrix built upon the solutions identified in the technological and organizational frames. Specifically, Table 5 seeks to identify relationships between the two identified variables in the overhead ISR optimization problem: technological segregation and organizational integration.

Table 5: Competition Frame Solution Matrix

CI = Competition's Impacts		**Organizational Integration**		
		I. Low: Separate organizations with distinct missions	**II. Medium: Blurred organizations with blurred missions**	**III. High: Shared organizations with shared missions**
Technological System Integration	**A. Low: Separate platforms**	*Case IA: Workable* CI reduced via system structure	*Case IIA: Not workable* CI reduced via system structure but increased via organizational structure	*Case IIIA: Optimal* CI mitigated via organizational structure and system structure
	B. High: Shared platforms	*Case IB: Not workable* CI maximized with no mechanism for mitigation	*Case IIB: Not workable* CI induced by organizational and system structures	*Case IIIB: Workable* CI mitigated via organizational structure

Source: Author's Original Work

In general, two trends are assumed across Table 5:

- *Increasing technological system segregation will reduce the impacts of competition.* As previously summarized, if tactical intelligence systems are segregated from strategic intelligence systems, the objectives of both execution agents and decision makers will more likely be met. Minimization of the negative impacts of the competition between objectives will result.
- *Increasing organizational integration will reduce competition's impact.* In theory, the more tightly integrated organizations become, the more the centralized leadership inherent in the organizational structure should be able to mitigate the negative impacts of the tactical/strategic objective competition. However, this relationship is more correctly captured as parabolic, rather than linear. In the middle ground—where partial overlap of organizational missions and only limited integration of organizational structures and leadership responsibilities exist—competition and its negative impacts increase beyond the weak centralized leadership's ability to mitigate. Blurred organizations each attempt to fulfill shared tactical and strategic objectives with only weak central leadership to guide and shape those efforts. Both sets of objectives suffer as the ultimate result.

Assessment of organizational system traits as outlined in Chapter 3 suggests the current overhead ISR system most closely resembles Case II: Blurred organizations with blurred missions. Organizationally, the system has evolved such that two separate and distinct organizations—black and white space—now struggle to distinguish between one another's roles. Organizationally, this is the worst possible scenario as it maximizes, rather than minimizes, the impacts of competition. As noted by the Independent Assessment Panel on the Organization and

Management of National Security Space, "Today, no one's in charge."[41] While missions are shared, "the authority and responsibilities for…intelligence space programs are scattered across the staffs of the DoD and the Intelligence Community."[42] This results, as predicted by Table 5, in "crippling shortfalls in the current system."[43]

Unfortunately, assessment of the system in the context of technological traits suggests similar shortfalls. As argued by General Kehler, and emphasized multiple times throughout this work, pursuing tactical and strategic objectives via "a small number of large, complex, long-lived satellites" has been the nation's "fundamental strategic approach."[44] Thus, while the organizations have remained separated, shared platforms have been developed to perform across the entire mission set. A small number of large platforms on-orbit today, controlled by committee, collect a broad set of ISR data. The result resembles case IIb in Table 5 and, as assessed in Chapter 4, is a system that, despite day-to-day operational success, meets neither execution agents' nor decision makers' broader critical objectives.

Inadmissible Solutions

The matrix of solutions captured in Table 5 suggests national strategies should pursue organizational integration over system segregation. While a system of fully integrated organizations and segregated tactical and strategic systems is most optimal, creating a strong, unified organization reduces the impacts of competition to workable levels *independent* of the level of technological system integration. Therefore, while pursuing both organizational integration

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[41] Young et al., *Leadership, Management and Organization for National Security Space*, 4.

[42] Young et al., *Leadership, Management and Organization for National Security Space*, 4.

[43] Young et al., *Leadership, Management and Organization for National Security Space*, 4.

[44] Kehler, "One Size Does Not Fit All".

and system segregation would provide maximum optimality, organizational integration should receive priority.

Before reaching such a conclusion, one final aspect of the overhead ISR system must be considered—constraints. The entire analysis to this point has failed to expand upon acceptable and unacceptable system behavior. Defined by optimal control theorists as "restrictions on the values that can be assigned to decision variables," constraints may be internally dictated as a result of the nature of the system or externally imposed.[45] System solutions that appear optimal but require decision variables to violate constraints—i.e. take restricted values—are deemed inadmissible.[46]

A less theoretical, but equally valid description of inadmissible solutions is to be found in Aesop's fable, "Belling the Cat." "A group of mice called together a committee to consider how to protect themselves from a cat that was harassing them. The best solution, one mouse proposed, was to bell the cat, which was met with general applause. But this left one key question: Who would put the bell around the cat's neck? Since there were no volunteers, the policy was useless."[47] In the context of optimal control, belling the cat was indeed an optimal solution but also an impossible one and therefore inadmissible. This assessment must now turn towards evaluating the admissibility of the solutions proposed.

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[45] Frederick S. Hillier and Gerald J. Lieberman, *Introduction to Operations Research*, 6th ed., McGraw-Hill Series in Industrial Engineering and Management Science (New York: McGraw-Hill, 1995), 12.
[46] Donald E. Kirk, *Optimal Control Theory: An Introduction*, Prentice-Hall Networks Series (Englewood Cliffs, NJ: Prentice-Hall, 1970), 7.
[47] Seth G. Jones, *In the Graveyard of Empires: America's War in Afghanistan* (New York: W.W. Norton & Company, 2009), 184.

Constraint: Fully Integrated Organizational Solutions Inadmissible

Evaluating overhead ISR system constraints best begins by considering a central conclusion from the *Report to Congress of the Independent Assessment Panel on the Organization and Management of National Security Space.* Seeking to identify the reason behind the continued failure of proposed solutions, the panel makes the following assertion: "Over the last two decades, numerous space commissions/panels have reviewed the management and leadership of national security space, and we have tried a multitude of solutions. But the current state of National Security Space clearly indicates that a bold step is now required. The attempts to make refinements have failed because they have not attacked the fundamental need for *an organizational structure that fosters rational decisions (*emphasis added)."[48] In making this assertion, the panel expands the organizational frame to identify a central tenet of any fully integrated organizational solution—the new organizational structure must be capable of fostering "rational decisions" in order to succeed.[49] In seeking to define admissibility, the question then becomes, "Is creation of a fully integrated organizational structure that fosters rational decision making possible?"

An initial read of the *Report on Challenges and Recommendations for United States Overhead Architecture* seems to indicate the required organizational changes are not only possible but will require relatively minor effort. The report's concluding paragraph bluntly states, "Fixing the issues that exist will not take a monumental effort like the Manhattan Project."[50] However, the paragraph goes on to include two

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[48] Young et al., *Leadership, Management and Organization for National Security Space*, 18.
[49] Young et al., *Leadership, Management and Organization for National Security Space*, 18.
[50] House, *Report on Challenges and Recommendations for United States Overhead Architecture*, 24.

caveats that make one skeptical: 1) achieving the required organizational changes will take "a paradigm shift" and 2) organizations involved "will need to step away from their respective parochial interests."[51] In short, achieving the desired level of organizational integration requires a paradigm shift in which decisions regarding the national overhead ISR system are made based on rational calculations rather than political or organizational interests. With all due respect to the members of the Subcommittee on Technical and Tactical Intelligence who submitted the report, achieving a paradigm shift of this magnitude will indeed require 'monumental effort.'[52]

Graham Allison and Philip Zelikow's *Essence of Decision* provides a framework for viewing the challenge that proponents of fully integrated organizational solutions face. In attempting to understand why the government of the United States responded to the Cuban missile crisis in the manner that it did, Allison and Zelikow propose three models to interpret government behavior.[53] Model I, the Rational Actor Model, views governmental action as the result of rational choices that seek to maximize value while minimizing costs in pursuit of a state's goals.[54] While assessing that "most analysts explain (and predict) behavior of national governments" in terms of Model I behavior, Allison and Zelikow propose "two alternative conceptual models."[55] Model II, the Organizational Behavior Model, eliminates the emphasis on deliberate, rational decision making and instead views governmental behavior as "outputs of large organizations functioning according to standard

[51] House, *Report on Challenges and Recommendations for United States Overhead Architecture*, 24.
[52] House, *Report on Challenges and Recommendations for United States Overhead Architecture*, 24.
[53] Graham T. Allison and Philip Zelikow, *Essence of Decision: Explaining the Cuban Missile Crisis*, 2nd ed. (New York: Longman, 1999).
[54] Allison and Zelikow, *Essence of Decision: Explaining the Cuban Missile Crisis*, 391.
[55] Allison and Zelikow, *Essence of Decision: Explaining the Cuban Missile Crisis*, 4-5.

patterns of behavior."[56] As governments are comprised of "large organizations" acting "quasi-independently," and as few important issues fall "exclusively within the domain" of a single organization, government behavior relevant to any important problem will reflect "the independent output of several organizations" only "partially coordinated by government leaders."[57] Model III, the Governmental Politics Model, counters by viewing governmental action not as "organizational outputs," but rather as the result of "bargaining games."[58] In this model, multiple players make government decisions not by "a single, rational choice," but by "the pulling and hauling that is politics."[59]

Viewing fully integrated organizational solutions in the context of Allison and Zelikow's models eliminates the viability of these solutions. Achieving fully integrated organizational solutions—the rational and optimal solution as shown in Table 5—requires setting aside both organizational behaviors and political interests. While such an approach is rational, its implementation is only possible if Model II and Model III behaviors are eradicated or suspended long enough for full organizational integration to occur. The number of organizational equities tied to, and the level of competition inherent in, the problem of overhead ISR system optimization make the suspension of organizational and political behaviors extremely unlikely. As a result, even if full organizational integration is the optimal and rational choice, Model II and Model III behavior will prevent it—thus eliminating its admissibility as a solution.

Numerous individuals interviewed in the course of this assessment concurred on the infeasibility of achieving fully integrated organizational solutions. Speaking of the Independent Assessment Panel's recommendation to create a consolidated National Security Space

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[56] Allison and Zelikow, *Essence of Decision: Explaining the Cuban Missile Crisis*, 143.
[57] Allison and Zelikow, *Essence of Decision: Explaining the Cuban Missile Crisis*, 143.
[58] Allison and Zelikow, *Essence of Decision: Explaining the Cuban Missile Crisis*, 255.
[59] Allison and Zelikow, *Essence of Decision: Explaining the Cuban Missile Crisis*, 255.

Organization, numerous Congressional staffers interviewed in February 2010 agreed this was a "step too far" that will "never happen."[60] One assessed the recommendation as an "untenable solution" and bluntly stated, "We'll never get there."[61] Even those who felt the recommendation was "an interesting thought" concurred that it "lacked support" and is unlikely to "go anywhere."[62] Lieutenant General James captured the situation well with his inclusion of politics among a short list of system constraints.[63] Until that political constraint is removed, fully integrated organizational solutions must be deemed inadmissible.

Recommendation #2: Acknowledge organizational politics as a primary constraint on the system and accept the associated result—creating an integrated organizational structure that fosters rational decision making across the national security space enterprise is not possible.

The Satisficing Solution

Having recognized the inadmissibility of fully integrated organizational solutions, Table 5 can now be modified to reflect that result. Table 6 captures the remaining options. As can be seen, Case IA, separate organizations with distinct missions and distinct platforms, while initially appearing less optimal than other potential solutions, now rises as the most workable solution. The emphasis on separate organizations with distinct missions is certainly more optimal than the Case II blurred mission scenarios where the nation's current strategy resides. The emphasis on separate platforms also further reduces the negative impacts of competition. While not the true optimum, it

[60] Interviews conducted by the author with five professional Congressional Staffers, 22-24 February 2010, Washington, DC. Notes in author's personal archives. Interviews were conducted in confidentiality and the names of interviewees are withheld by mutual agreement.
[61] See note 59.
[62] See note 59.
[63] Lieutenant General Larry D. James, interview by the author, 5 February 2010, Montgomery, AL. Audio recording in author's personal archives.

represents that solution that is "good enough" in the face of system objectives, components, and constraints.[64] This is a classic case of the previously introduced operational research concept of "satisficing"—"if a solution is found that enables all…goals to be met, it is likely to be adopted without further ado."[65]

Recommendation #3: Transition the national overhead ISR strategy to one that is "good enough"—separate organizations with distinct missions and separate platforms.

Table 6: Constrained Solution Matrix

CI = Competition's Impacts		**Organizational Integration**		
		I. Low: Separate organizations with distinct missions	**II. Medium: Blurred organizations with blurred missions**	**III. High: Shared organizations with shared missions**
Technological System Integration	**A. Low: Separate platforms**	*Case IA: Workable* CI reduced via system structure	*Case IIA: Not workable* CI reduced via system structure but increased via organizational structure	*Case IIIA: Optimal* CI mitigated via organizational structure and system structure
	B. High: Shared platforms	*Case IB: Not workable* CI maximized with no mechanism for mitigation	*Case IIB: Not workable* CI induced by organizational and system structures	*Case IIIB: Workable* CI mitigated via organizational structure

Source: Author's Original Work

[64] Hillier and Lieberman, *Introduction to Operations Research*, 15.
[65] Hillier and Lieberman, *Introduction to Operations Research*, 15.

The technological piece of the satisficing solution is straightforward and is correctly captured by General Kehler's concept that "one size no longer fits all."[66] The nation will need "new systems configured optimally to serve particular tactical needs, new measures to protect them, and new ways to operate and sustain them."[67] Whether these evolve as responsive, small satellites like those being pursued by the Operationally Response Space Office or take some other form is not of tremendous importance. Developing a technological architecture that allows for "platforms purposely designed for specific warfighter or national intelligence needs" is the critical factor.[68]

Equally critical to the satisficing solution is rapidly resolving the organizational component. Fourteen years ago the Jeremiah Panel recommended the "relationships between the NRO and DoD space organizations" should be refined and clarified.[69] In 2008, the *Report on Challenges and Recommendations for United States Overhead Architecture* report found confused relationships remain a hampering factor: "Programs jointly funded in the National Intelligence Program (NIP) and Military Intelligence Program (MIP), requiring joint decisions by the DNI and DOD, result in delayed program starts…The acquisition process would benefit greatly by moving away from joint funding and by *having more clearly defined authorities (*emphasis added)."[70] Optimization will not be achieved until relationships are refined and authorities clarified.

The precise nature of the separate and distinct organizational structure remains open to debate, but this is a debate that must be had. Centered upon, as Faga recommends, separate and distinct "lanes in the road," the debate must seek to identify organizational structures in

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[66] Kehler, "One Size Does Not Fit All".
[67] Kehler, "2008 Global Warfare Symposium Keynote".
[68] Kehler, "One Size Does Not Fit All".
[69] Jeremiah Panel, *Defining the Future of the NRO for the 21st Century*, (Washington, DC, 26 August 1996), 9.
[70] House, *Report on Challenges and Recommendations for United States Overhead Architecture*, 2.

support of this objective.[71] One option for distinction, also suggested by Faga, is dividing authorities and missions along the lines of surveillance and reconnaissance—a division that makes tremendous sense given the relationship of each of these broader missions to the differing needs of execution agents and decision makers. Such a division would also allow the NRO to "remain a strong, separate activity, with a focus on innovation"—a recommendation of the National Commission for Review of the NRO in 2000 and a key need of decision makers.[72] This division would similarly provide an organization focused on assuredness for those who "intend to go in harm's way."[73] Other alternatives may exist but each must seek to mitigate the impacts of competition between the competing objectives of execution agents and decision makers by separating the responsibilities for them.

Effective Efficiency?

Two logical challenges arise to the proposed solution of distinct organizations and independent platforms. First, the nation has made a conscious effort over the last few decades to integrate black and white space more tightly. Why reverse course now? Second, the solution proposed here is less efficient than an integrated solution. How then can it be admissible in the context of budgetary or other efficiency constraints?

The answer to both of these challenges centers upon the effectiveness and efficiency of current integrated strategies. The nation should reverse course and accept higher perceived inefficiencies for the simple reason that existing strategies have proven neither effective nor

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[71] Martin C. Faga, interview by the author, 24 February 2010, Tysons Corner, VA. Audio recording in author's personal archives.
[72] National Commission for the Review of the National Reconnaissance Office, *The NRO at the Crossroads*, 4.
[73] John Paul Jones as quoted in Kehler, "One Size Does Not Fit All".

efficient. Consider the case of Space Based Radar (SBR) as summarized by General Kehler:

> We have attempted for over a decade now to produce a space radar system. Something that's cutting edge. Yet we haven't fielded that. Why not? We have a validated set of requirements. We certainly see the value in night time and all weather reconnaissance and tracking which is what you get out of a radar system. We have the technical capability to build such a system. And while likely expensive, we could prioritize and fund such a system. I don't buy that we just couldn't afford it. I believe that you can decide to afford something if you need it enough. We have smart, dedicated people to operate it, and by the way, it isn't because somehow the warfighters and the intelligence community can't figure out how to get along. I've been in those meetings. That's not the issue. I think the issue is one size no longer fits all.[74]

Essentially, the nation's attempts at fielding a capability for decision makers and execution agents via an efficient "one size" approach have resulted in a decade long effort that has produced little effective capability for the nation.[75] It is difficult to argue that such an approach has proven efficient or effective.

Similar stories can be told for other national attempts at developing needed space capabilities efficiently. As discussed in Chapter 3, the SBIRS program was a classic case of the "one size" approach as it attempted to merge four related but distinct missions onto one platform. Unlike Space Based Radar, the program has provided some effective capability to the nation. However, as reported in a 2010 Government Accountability Office (GAO) study, the capability provided by the program is "one less satellite" and "a series of deferred requirements" below the original baseline at roughly three times the initially estimated cost.[76]

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[74] Kehler, "2008 Global Warfare Symposium Keynote".
[75] Kehler, "2008 Global Warfare Symposium Keynote".
[76] Cristina T. Chaplain, *Space Acquisitions: DOD Poised to Enhance Space Capabilities, but Persistent Challenges Remain in Developing Space Systems*, (Washington, DC: Government Accountability Office, 2010), 2-3.

A comparable program, the National Polar-Orbiting Environmental Satellite System (NPOESS) was initiated in 1994 by The National Performance Review which reported that “converging the existing polar (weather) systems from the Department of Commerce (DOC) and Department of Defense (DoD) would result in a more cost efficient integrated system.”[77] Like both Space Based Radar and SBIRS, neither maximum effectiveness nor increased efficiency has resulted. The same 2010 GAO report referenced above found the NPOESS program on track to deliver “fewer key sensors” and “two fewer satellites” at over twice the original cost estimate.[78]

Fortunately, unlike, SBR and SBIRS, the challenges of the integrated approach for developing NPOESS have been recognized and rectified. In February 2010, the White House assessed the major challenge of NPOESS to be the joint execution of the program “between three agencies of different size with divergent objectives and different acquisition procedures.”[79] As a result of this assessment, the White House directed a distinct move away from efficiency in favor of effectiveness—“The new system will resolve this challenge by splitting the procurements.”[80] NPOESS thus becomes an ideal case of the nation replacing ineffective efficiency with a more effective, segregated approach. A similar rationale should justify adopting the overhead ISR strategic solutions recommended by this analysis.

While all space acquisition programs experience requirements shift and cost growth, the general trend appears to be one in which programs

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[77] National Polar-orbiting Operational Environmental Satellite System Integrated Program Office, "About the NPOESS Program," http://www.ipo.noaa.gov/index.php?pg=about&tab=2.

[78] Chaplain, *Space Acquisitions: DOD Poised to Enhance Space Capabilities, but Persistent Challenges Remain in Developing Space Systems*, 2-3.

[79] National Polar-orbiting Operational Environmental Satellite System Integrated Program Office, "Restructuring the National Polar-orbiting Operational Environmental Satellite System" (Fact Sheet, 1 February 2010).

[80] National Polar-orbiting Operational Environmental Satellite System Integrated Program Office, "Restructuring the National Polar-orbiting Operational Environmental Satellite System".

that pursue the one size fits all approach, complete with the integration of systems and organizations, produce both *less efficiency and less capability* for the nation. While efficiency is a laudable goal, it should not be pursued at the expense of effectiveness. The Subcommittee on Technical and Tactical Intelligence found, "The nation cannot afford to continue to ignore the issues that hamper the *effective* development and management of an integrated space architecture (emphasis added)."[81] While the emphasis on integration is misplaced, the emphasis on effectiveness hits the mark. Admittedly a strategy of separate systems and distinct organizations is a move away from the efficiency efforts of the past two decades. This should not, however, preclude the nation from pursuing the effectiveness that the critical ISR mission demands.

Conclusion

Typical assessments of the nation's overhead ISR strategy have sought to frame the problem as one of either technological deficiency or organizational shortfalls. Viewing the strategy through a technological frame drives solutions seeking to minimize those technical system traits negatively impacting the optimality of the current system. Solutions focused on the segregation of on-orbit platforms emerge as leading candidates in the technological frame. Alternatively, the organizational frame suggests maximizing organizational integration may be the answer. By reframing the problem as one that recognizes the system's inherent competition and seeks to minimize the negative impacts of that competition, a more complete solution emerges. The truly optimal strategy, for an unconstrained system, would include tightly integrated organizations and segregated systems. Theory suggests organizational politics will preclude the admissibility of such a solution. Lacking the ability to achieve true optimality, the nation should pursue the solution

[81] House, *Report on Challenges and Recommendations for United States Overhead Architecture*, 6.

that is good enough. By moving towards separate organizations with distinct missions supported by segregated platforms, the nation can best optimize its national overhead ISR strategy.

Conclusions

> *(The NRO) must remain a strong, separate activity, with a focus on innovation…Failure to understand and support the indispensable nature of the NRO as the source of innovative new space-based intelligence collection systems will result in significant intelligence failures. These failures will have a direct influence on strategic choices facing the nation and will strongly affect the ability of U.S. military commanders to win decisively on the battlefield.*
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> *Report of the National Commission for the Review of the National Reconnaissance Office, 2000*

> *One size doesn't fit all. One size shouldn't try to fit all.*
>
> *General Robert C. Kehler*
> *Commander, Air Force Space Command*

The "Overall Finding and Conclusion" of the National Commission for the Review of the National Reconnaissance Office—quoted above—is intriguing.[1] Over a decade ago, this commission identified key components of an optimal national ISR strategy: a) the NRO must remain a separate activity; b) the NRO's focus should be on innovation; and c) overhead intelligence has two separate and distinct functions—informing national strategic choices and influencing decisive victory.[2] The only piece of an optimal solution the NRO Commission failed to capture in their overall finding is the segregation of platforms—a concept added to the solution set by Kehler in 2008.

Through an evaluation framed by concepts found in optimal control theory, this assessment arrives at similar conclusions. While both national decision makers and execution agents rely upon overhead

[1] National Commission for the Review of the National Reconnaissance Office, *The NRO at the Crossroads*, (Washington, DC, 2000), 4.
[2] National Commission for the Review of the National Reconnaissance Office, *The NRO at the Crossroads*, 4.

ISR to succeed in their distinct missions, review of system objectives in the context of existing system organizational and technical traits suggests the current system fails to meet the differing objectives of either user set optimally. By assessing solutions in the context of system constraints, this study proposes an optimal solution—one that is both admissible and good enough—lies in concepts very similar to those outlined by the NRO Commission and Kehler: Separate organizations with distinct missions and segregated platforms to execute those missions.

This study also identifies why, with both a decade-old assessment and a current senior leader recommending moves in the right direction, achieving this identified optimal solution has remained elusive. In short, the nation's pursuit of ideal, but unachievable, solutions has driven this elusiveness. Since 1991, when space demonstrated its tactical utility in the Gulf War, the nation has been fixated on tighter space integration. While integrating DoD and IC overhead intelligence systems and organizations seamlessly is an outstanding theoretical ideal, achievement of full integration is a practical impossibility. This study suggests that clinging to this ideal in the face of realities will prevent the achievement of that ideal and prolong the system's overall ineffectiveness.

Assessment

While acknowledging the existence of differing missions for decision makers and execution agents, some argue weaknesses in the current system are minor. Focusing on existing day-to-day operations, they rely on the success in current operations as evidence the system is already good enough. If half the Combatant Commanders are, as NRO Director Carlson found, "incredibly complimentary of what the (NRO) is doing," how can one claim a lack of optimality in the current system?[3]

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[3] Bruce Carlson, "2009 GEOINT Symposium Keynote" (Address, GEOINT 2009 Symposium, San Antonio, TX, 21 Oct 2009).

This perspective is also evident in the 2008 Congressional *Report on Challenges and Recommendations for United States Overhead Architecture* which claims, "When asked to list requirements that have not been satisfied by current systems, DOD did not identify a single unsatisfied intelligence need to the Committee."[4]

By focusing on the "deep fundamentals," and assessing the critical objectives of overhead ISR for both decision makers and execution agents, this study identifies a framework that rejects such claims.[5] Building upon Lieutenant General Deptula's seventeen key ISR system components, this work identifies critical variables for both decision makers and execution agents.[6] As the primary purpose of intelligence for decision makers is developing estimates of the enemy to guide political strategy, system exquisiteness and inconceivability—capabilities the adversary cannot even envision one as having—are required. Conversely, the execution agent who relies upon overhead ISR to defeat near real-time threats decisively cares little about exquisiteness and much more about timeliness, frequency, and assuredness of support. Assessing the system's true optimality becomes possible not by appraising day-to-day operations, but rather by evaluating the extent to which the current system meets these distinct, critical variables for execution agents and decision makers.

Through the correlation of system traits and identified objectives, this assessment concludes that the current system provides neither exquisiteness nor assuredness very well. An historical review of both black and white space suggests the current system has reached the point that, while both AFSPC and the NRO exist as separate and distinct

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[4] House, *Report on Challenges and Recommendations for United States Overhead Architecture*, 110th Cong., 2nd sess., 2008, H. Rept. 110-914, 11.

[5] David A. Deptula, *Lead Turning the Future: The 2008 Strategy for United States Air Force Intelligence, Surveillance and Reconnaissance*, (Washington, DC: Headquarters, United States Air Force, July 2008), 16.

[6] Deptula, *Lead Turning the Future: The 2008 Strategy for United States Air Force Intelligence, Surveillance and Reconnaissance*, 17.

organizations, their missions have become increasingly blurred. A similar review of the current system's technical traits uncovers a system with few on-orbit platforms controlled by committee attempting to perform broad sets of missions in increasingly contested environments. Importantly, the system is also declining in both government exclusivity and innovation. Neither the organizational construct of distinct organizations with blurred missions, nor the prevalent tactical traits suggest optimal levels of exquisiteness or assuredness in the system.

Solutions

The current system fails to provide optimal levels of either exquisiteness for decision makers or assuredness for execution agents as it focuses, both organizationally and technically, on balancing the competitive set of requirements rather than maximizing either. As captured by the director of national intelligence, this balancing approach has ultimately led to "criticism from virtually every side of the spectrum."[7] Multiple commissions and assessments all agree—the current system needs to be improved.

Given the failure of current approaches, this study offers that solutions to the problem must focus on minimizing the negative impacts of the inherent execution agent/decision maker competition in a manner other than balancing. The fundamental problem is assessed not as one of modification of technological or organizational system traits, but rather as one centered on competition. How can the nation create an environment in which the inherent competition of decision makers and execution agents remains, but its impacts are minimized to an extent that both user set's objectives are met?

Traditional efforts to increase system optimality by focusing on organizational integration indirectly attack this problem. By bringing the

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[7] Quoted in Stew Magnuson, "Lost in Space: Struggling Spy Satellite Agency Tries to Right Itself," *National Defense*, January 2010, 39.

Intelligence Community and Department of Defense together, joint leadership may indeed mitigate the problems caused by competition. The 2008 Young Panel's appeals for creating a combined National Security Space Organization, or the current NRO director's urge to re-create an Executive Committee, demonstrate this approach.

While theoretically optimal, this study deems fully integrated organizational solutions inadmissible. Through a focus on system constraints—namely organizational and political decision making models—this analysis suggests fully integrated organizational solutions are unachievable. Organizational equities have become so firmly entrenched over the last half century that expecting one community's subservience to the other is a false hope. The government simply cannot implement the extent of organizational change required to mitigate the system's inherent competition.

Additionally, the study suggests that partially integrating, when full integration is impossible, results in the least optimal system performance. Shared leadership mechanisms lacking requisite authorities lead to blurred organizational missions and boundaries—a recipe for maximizing, not minimizing, the impacts of the system's inherent competition. When organizational missions partially overlap and organizational structures and leadership responsibilities are only integrated to a limited extent, competition and its negative impacts increase beyond the weak centralized leadership's ability to mitigate them. Blurred organizations each attempt to fulfill shared tactical and strategic objectives with only weak central leadership to guide and shape those efforts. Both sets of objectives ultimately suffer.

In the presence of these constraints, the study finds establishing distinct lanes in the road as the only viable solution. A strategy that distinguishes the roles and missions of DoD and IC space organizations and pursues separate platforms to support those distinct missions will eliminate negative organizational and technological traits of the current

system, leading ultimately to minimizing competition's impacts—the ultimate goal. In short, the optimal solution will mitigate the inherent competition in the system by purposefully segregating organizations and systems.

Some suggest abandoning integration in favor of segregation will produce inefficiencies. This study briefly assessed recent attempts to provide effective capability through integrated solutions and found evidence the system cannot be much more inefficient. After years of pursuing an integrated solution, the National Polar-orbiting Environmental Satellite System (NPOESS) was on track to deliver two fewer satellites than planned at twice the original cost estimate.[8] In 2010, the White House directed NPOESS to return to a segregated approach.[9] Brief reviews of other recent integrated efforts, including Space Based Radar (SBR) and Spaced Based Infrared System (SBIRS), found similar results—effective capability declining with costs sky-rocketing. While fully assessing these programs remains an area for future research, this study suggests a general trend in which programs that pursue the one-size-fits-all approach, complete with the integration of systems and organizations, result in both less efficiency and less capability for the nation. As such, while efficiency is a laudable goal, this assessment concludes it should not be pursued at the expense of effectiveness.

Fundamentally then, General Kehler was more correct than even he knew or, perhaps, intended to be: "One size doesn't fit all. One size shouldn't try to fit all."[10] The foundational objectives of decision makers

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[8] Cristina T. Chaplain, *Space Acquisitions: DOD Poised to Enhance Space Capabilities, but Persistent Challenges Remain in Developing Space Systems*, (Washington, DC: Government Accountability Office, 2010), 2-3.
[9] National Polar-orbiting Operational Environmental Satellite System Integrated Program Office, "Restructuring the National Polar-orbiting Operational Environmental Satellite System" (Fact Sheet, 1 February 2010).
[10] C. Robert Kehler, "2008 Global Warfare Symposium Keynote" (Address, Global Warfare Symposium, Beverly Hills, CA, 21 Nov 2008).

and execution agents distinctly differ. These inherent differences drive insurmountable competition in the national overhead ISR system. No one-size solution will ever succeed in minimizing this competition to a sufficient level that would ensure fulfilling either party's foundational objectives. Only by acknowledging the inherent competition in the system, accepting the inadmissibility of both organizationally and technologically integrated one-size solutions, and establishing distinct lanes in the road can the nation succeed in meeting the national security overhead ISR needs of the 21st century.

List of Interviewees

The following individuals were interviewed as part of this study. While not all individuals were directly quoted in the text of this study, all had a tremendous impact in shaping the thoughts and direction of the study. Notes from all interviews along with audio recordings from those who were willing are maintained in the author's personal collection.

Maj Gen (Ret) Jim Armor, former Director, National Security Space Office
Lt Gen David Deptula, AF/A2
Mr. Marty Faga, former D/NRO
Mr. Keith Hall, former D/NRO
Mr. Jeff Harris, former D/NRO
Mr. Josh Hartman, former senior advisor to USD/AT&L
Lt Gen Larry James, Commander, JFCC Space, U.S. Strategic Command
Dr. Paul Kaminski, former USD/AT&L
Mr. Keith Masback, President US Geospatial Intelligence Foundation
Mr. Richard McKinney, Special Assistant to SECAF
Gen (Ret) Thomas Moorman, former VCSAF
Mr. Joseph Rouge, Director, NSSO
Dr. Pete Rustan, Director, Mission Support Directorate, NRO
Col David (DT) Thompson, AFCENT Director of Space Forces (DS4)
Col Jeff Yuen, former AFCENT Director of Space Forces (DS4)

*Five professional Congressional Staffers were also interviewed but per their request for anonymity are not identified here by name or position.

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